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AGRICULTURAL LEDGER.

1895—No. 8.

INDIAN CULTIVATED COTTONS.

(GOSSYPIMUM.)

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DESCRIPTIONS OF CERTAIN INDIAN BOTANICAL
FORMS OF COTTON (GOSSYPIMUM).

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DESCRIPTIONS OF CERTAIN INDIAN BOTANICAL
FORMS OF COTTON.



T. S. MIDDLETON, B. Sc.,
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[*Dictionary of Economic Products*, Vol. IV, G. 381—651]

Descriptions of certain Indian Botanical Forms of Cotton (Gossypium) by
T. H. MIDDLETON, B. Sc., *Professor of Agriculture, Baroda College.*

INTRODUCTION.

IN the following notes an attempt has been made to describe botanically some of the leading forms of Indian cultivated cotton. The descriptions have been made from living plants and not from dried specimens.

My attention was first drawn to the study of the cotton plant by the appearance of the article **Gossypium** in the *Dictionary of Economic Products*, Dr. Watt, who I understand is more especially responsible for the botanical portions of that article, points out, in the opening paragraphs, that the greatest confusion exists with respect to Indian cottons, and that, though cultivated forms are numerous, very little is positively known about them.

Considering the importance of the plant from a commercial standpoint, the effort that Government has made to improve the staple, and the interesting nature of the subject, from a botanical point of view, it is surprising that so little attention has been paid to the relationships that exist between the Indian members of the genus **Gossypium**. A considerable amount of discussion has taken place regarding the number of species of cotton found in the country, but since Roxburgh penned his descriptions of the cottons of Bengal, few fresh observations have been recorded in this country and no one (until Dr. Watt took up the question a second time, some three years ago) has attempted a complete census of the forms of cotton cultivated in India.

For four years I have cultivated cottons, obtained from correspondents in all parts of India, on the College Farm, Baroda, and I have thus become acquainted with a large number of forms, and have had opportunities of studying their behaviour in different seasons and on different soils. The descriptive notes which I have put together here, at the request of Dr. Watt, will, I hope, be found accurate; they have in most cases been verified on many specimens of each form. For a thorough differentiation of the various races, the plants would have to be studied as field crops; and, except in the case of the Gujarat forms, I have not examined the Indian cottons in their native districts. I have, therefore, had to attempt to discount the effects of a foreign soil and altered climate upon plants coming from other parts of India, but, I venture to think, that I have fairly successfully indicated all the more important distinctions between the different forms.

The following remarks on the effects of soil and climate on the habit and structure of the cotton plant may assist readers in cases where discrepancies exist between my descriptions of the plants received from a particular district, and the actual characters of the plant as found growing in that district.

Habit.—Soil affects the size and general appearance of the cotton plant to a very great extent. On sandy loams and well-drained land most cottons are tall, lax in habit, with long, weak, spreading branches; on clay and badly-drained soils they are small bushes with short branches.

Hairs.—These are not perceptibly affected in the first season by a change of soil and climate.

Stems, Petioles & Peduncles are affected in size by a change in habit, but are not otherwise altered by a change of soil.

Leaves, Stipules & Bracteoles are greatly affected in size, and the first and last to some extent in conformation, by change of climate. These leafy organs are very different in a moist atmosphere from what they are in a dry, and herbarium specimens may be misleading if, e.g., some are made in the monsoon and others in the dry season. The sinuate character of the leaf of the *G. herbaceum* series of cottons is only marked in the monsoon, and the extra lobe of the *G. arboreum* series is more common and more marked during this season than it is afterwards. The bracteoles of the annual and shallow-rooted cottons diminish markedly in size as the hot season advances.

Flowers.—These do not alter perceptibly in form or colour by transference to a new district. If the plant is healthy the flowers will be normal; but like the bracteoles they diminish in size late in the season.

Bolls.—The bolls also become smaller especially on light soils, as the hot season advances, but those that form early in the season should be true to kind whether grown on clay or sandy soil.

Seeds.—In those bolls which mature well, the size or number of the seeds is not affected during the first season by a change of soil and climate.

Lint.—The fibre, more than anything else, is injuriously affected by change, but my remarks on the quality of the staple are of little practical value, in many cases I have omitted a notice of it altogether. The commercial value of the cotton produced by each district is well known, and as my object in growing the plants was not to classify the staples, but to ascertain the botanical characters of each form, the failure of the plants to produce good cotton is of less importance than at first sight it might seem to be.

The cottons experimented with were generally grown on a sandy loam soil, freely drained. The majority were also grown on a badly-drained and heavier soil. The seed was sown at various periods from the beginning of June until the beginning of August and the plants were allowed to occupy the ground until they died in the hot weather. Many of the later forms that lived through the hot season were permitted to shoot again in the second monsoon.

Cottons planted at the beginning of June were irrigated until rain fell. With a few exceptions none of the varieties were irrigated at other seasons.

The following table shows the rainfall at the College Farm for the monsoons of 1892, 1893, 1894, and 1895:—

MONTH.		RAINFALL.			
		Year 1892.	Year 1893.	Year 1894.	Year 1895.
June	{ First fortnight . .	·81	1·72	4·41	·58
	{ Second ditto . .	2·87	11·29	7·66	2·91
July	{ First ditto . .	5·26	11·44	13·99	·46
	{ Second ditto . .	3·68	3·32	13·88	13·43
August	{ First ditto . .	3·57	3·80	·85	6·57
	{ Second ditto . .	7·81	2·66	2·68	·79
September	{ First ditto . .	10·68	4·70	9·62	1·74
	{ Second ditto . .	2·70	1·71	3·23	·37
October	{ First ditto . .	...	·06	...	...
	{ Second ditto . .	·21	...	6·36	1·07
November	{ First ditto . .	...	...	...	...
	{ Second ditto . .	...	·63	...	...
		37·59	41·33	62·68	27·92

The following is a list of the cottons I have grown and examined, as also of the districts from which the seeds were obtained :—

NAME OF COTTON.		Districts from which seeds were obtained.	Page.
I. Gujarat Cottons.	<i>Deshi</i> Cotton of Broach or <i>Kahnami Kapas</i> .	Broach, Etola, Miagam, Palej, Dabhoi, Kim, Nawsari	1
	<i>Goghari Kapas</i>	Jambusar, Etola.	2
	<i>Gundi Goghari Kapas</i>	Etola.	3
	<i>Ambli Kapas</i>	Ambli (Dhollera District).	ib.
	<i>Sakalia Kapas</i>	Dhollera District.	ib.
	<i>Deshi</i> Cotton of Kathiawar	Bhavnagar, Palitana, Amreli, Junagardh.	ib.
	Wild Cotton of Kathiawar	Palitana Rajkote.	ib.
	<i>Lallo Kapas</i>	Bhavnagar, Palitana Dhola.	ib.
	<i>Kanvi</i> or <i>Kanpui Kapas</i>	Botad, Amreli, Junagardh.	4
	<i>Wagria Kapas</i>	Botad, Wadhwan, Dhrangadhra, Morvi, Viramgam.	ib.
	<i>Mathia Kapas</i>		
	Hybrids between <i>Mathia</i> and <i>Kanvi</i> .	Bhavnagar.	
II. Dharwar Cottons. (S. Maratha.)	<i>Roji</i> or <i>Jaia Kapas</i>	Baroda.*	5
	<i>Coompta</i> Cotton	Dharwar.	7
	Saw-ginned Cotton	Ditto.	ib.
III. Madras Cottons.	<i>Tellapatti</i>	Bellary, Kurnool.	ib.
	<i>Uppam, karunkanni</i> , Cotton	Tinnevely, Coimbatore.	ib.
	<i>Nadam</i> Cotton	Coimbatore.	8
	<i>Yerrapatti</i>	Kistna, Kurnool.	ib.
VI. Bengal Cottons.	<i>Karunkanni</i> Cotton	Tinnevely.	ib.
	<i>Desi</i> Cotton of Sarun	Chupra.	9
	<i>Disilla</i> Cotton of Sarun	Sewan.	ib.
	<i>Fethayi</i> Cotton	Gopalgunj.	ib.
	<i>Bhoglla</i> Cotton	Sewan, Gopalgunj.	ib.
	<i>Kapas</i>	Burway and Taree, Lohardagga.	
	<i>Chandapara</i>	Lohardagga.	
	<i>Bhoglla</i>	Ditto.	9
	<i>Kherdya Kapas</i>		10
	<i>Nurdki</i>		11
	<i>Borea</i>		ib.
	<i>Burdy</i>		ib.
	<i>Malgacha</i> (<i>G. hirsutum</i>). . . .		
V. Cottons of Central Provinces, Berar and Khandesh.	<i>Narma</i> (American Cotton)	Gopalgunj and Sewan, Sarun.	
	<i>Bani</i>	Central Provinces, (grown at Nagpore Farm).	12
	<i>Jari</i>	Ditto (ditto).	ib.
	<i>Nimari</i>	Central Provinces, Nimar District, (grown at Nagpore Farm).	13

* I have examined this cotton in many districts, it grows everywhere in the country between Baroda and Ahmedabad.

NAME OF COTTON.		Districts from which seeds were obtained.	Page.
VI. Cottons of Panjab, North-West Provinces, Rajputana, and Sind.	<i>Gowrani</i>	Khandwa.	12
	<i>Katil Belati</i>	Akote.	13
	<i>Varadi</i>	Bhosawal.	ib.
	<i>Khangaum</i> Cotton	Khangaum.	12
	<i>Narma (G. arboreum)</i>	Shahpur, Panjab.	14
	<i>Bajwara</i>	Ditto ditto.	
VII. Cottons of N.-W. Provinces.	<i>Bagar</i> or Cottons of North-Western Provinces, <i>Watni</i> <i>Kapas</i> .	Ditto ditto.	15
	<i>Kapas</i>	Rawalpindi.	14
	Ditto	Amballa.	ib.
	Ditto with yellow floss	Ditto.	ib.
VIII. Cottons of Rajputana.	Ditto	Saharanpore.	
	Ditto	Cawnpore.	16
IX. Cottons of Sind.	Ditto	Jeypore.	ib.
	Wild Cotton	Marwar.	17
X. Assam Cottons .	Ditto	Sind.	ib.
	<i>Kapas</i>	Hyderabad.	
	<i>Bungai</i>	Habiganj, Karinganj, and Sylhet.	19
	<i>Bhoga Khapa</i>	Sibsagar.	ib.
	<i>Khansa</i>	North Cachar.	ib.
	<i>Kunma</i>	Ditto.	ib.
	<i>Shet</i>	Lakhimpur.	ib.
	<i>Ukynphad</i>	Khasi and Jaintia Hills.	ib.
	<i>Kil</i>	Garo Hills.	20
	<i>G. arboreum</i> .		ib.
XI, Miscellaneous Cottons.	<i>G. herbaceum</i> (Persian Cotton).	Karachi.	18
	<i>G. religiosum</i> .		21
	<i>G. brasiliense</i> .		22
	<i>G. barbadense</i> .		21
	<i>G. maritimum</i>	Sea Island and Egyptian varieties.	20
	<i>G. hirsutum</i>	Many American cultivated varieties.	ib.
	Okra-leaf Cotton	Alabama, U. S. A.	2 5

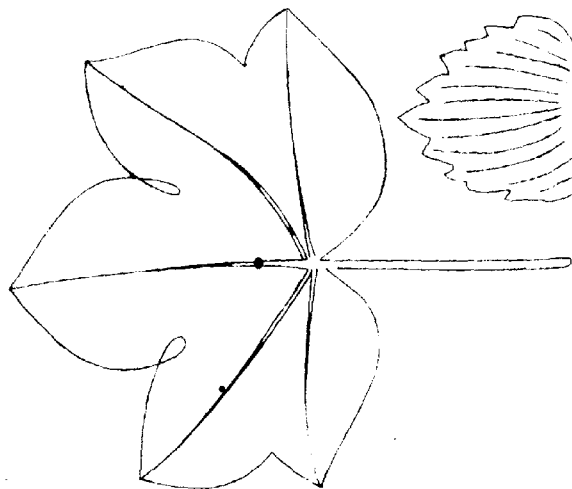
In the matter of nomenclature, I have followed the classification of *Todaro* as explained in the Dictionary of Economic Products. I have, however, used the old name *G. herbaceum* for the plant which he isolates as *G. Wightianum*, as I am unable to accept the distinction which he makes between these species. From my own experience in growing Indian cottons, I think that *Todaro* has named far more species of *Gossipium* than actually exist. The only species

described by him, which I have found traces of in our indigenous field crops are, **G. herbaceum**, **G. arboreum** (in hybrids only), **G. roseum**, **G. indicum** and **G. neglectum**, and of these five **G. indicum** may possibly be but a marked variety of **G. herbaceum**, and **G. neglectum** a hybrid cotton.

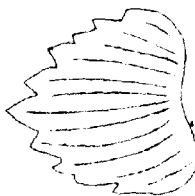
I am much indebted to numerous correspondents who have kindly furnished me with samples of cotton seed and with information regarding the cottons of their districts. I would more especially mention the assistance rendered to me by the Directors of Agriculture in Assam, Bengal, the Central Provinces the Panjab, and the North-West Provinces, (Messrs. Darrah, Macpherson Fuller, Robertson, and Miller); and Dr. Hendley, Jeypore; Professor Mell, Alabama, United States of America; Messrs. Benson, Madras; Mollison, Poona; MacNaghten, Rajkote; and Gaddam Bythel & Co., Bombay.

I. G. herbaceum

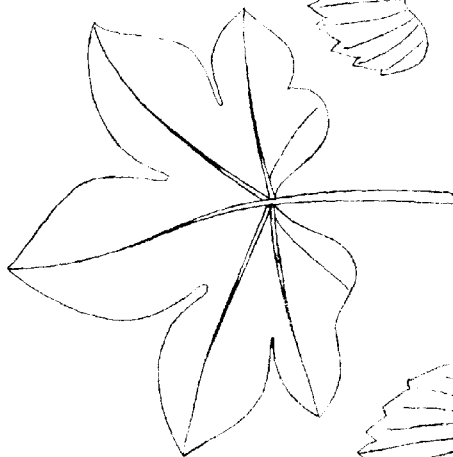
Common Types of Leaves and Bracteoles



Leaf of *G. herbaceum*
Cotton



Bracteole of
G. herbaceum Cotton



Leaf of *G. herbaceum*
Cotton



Bracteole of
G. herbaceum Cotton
Ball beginning to
open.

I.—GUJARAT COTTONS.

GUJARAT
COTTONS.

(1) **Broach Cotton**.—This form is known in the Broach and Surat districts as *Deshi* and by cultivators in Baroda and Kaira as *Kahnami*, i.e., the cotton of the *Kahn*am,—the black soil district round Broach.

Description.—A shrub usually 3–4 feet high, but varying greatly according to the soil. In heavy clay in which water stagnates it is usually 1–1½ feet, in well-drained and fertile loams it grows to 5 or 6 and occasionally to 7 or even 8 feet high. Perennial under favourable circumstances, but cultivated as an annual. Whole plant hairy, young leaves and bracteoles pubescent, hairs stellate or 3–4-branched, petioles, leaf-ribs and peduncles villous, hairs simple (a few stellate or branched hairs occur on the ribs). Young parts covered with elliptical black glandular dots which may be plainly seen on rubbing off the hairs. *Stem*, woody below, herbaceous above; the young stem where exposed to the sun is reddish, on the under surface it is green, it is much softer and not so dark-coloured as in the *G. arboreum* series of cottons; in a strong plant it is 1 inch or more in diameter at the base, and is either tall with short branches, or short and much branched. Branches ascending in tall plants or spreading and strongly developed when the main stem has not grown much; the primary branches bear secondary branches and these bear flowers, or usually again branch. *Leaves* very variable, cordate; lower and larger leaves 5–6–7, upper 3–5-lobed, half or less than half segmented; middle lobe ovate acute, mucronate, constricted at the base; the upper leaves often rounded obtuse; side-lobes slightly oblique ovate, acute or obtuse with a very short point; sinuses often folded, and occasionally in the monsoon when growth is luxuriant the fold forms a distinct extra lobe; margins sinuate especially in damp weather; both upper and under surfaces soft and mossy green when young, the upper becoming darker and slightly leathery when old; midrib with a gland; the side ribs rarely glandular; larger leaves from 2–4 inches in diameter; small upper leaves 2 inches, nearly as long as broad; petioles $\frac{3}{4}$ length of leaf-blade, very slightly thickened at the base; stipules persistent, linear acuminate $\frac{1}{2}$ inch to 1 inch long, those on peduncles markedly unequal, one of them oblique, secondary or tertiary, ovate, truncate, toothed, the other lanceolate acuminate. *Flowers* on tertiary or secondary branches, each branch with 2–3 flowers, sometimes 4 or more. *Peduncles* not quite in the axil of the leaf, but not so distinctly extra-axillary as in *G. arboreum*, as long as the petioles of the bracts when flowers open, shorter when in fruit, trigonous to terete. *Bracteoles* variable in size, usually less than half the length of the corolla, broadly ovate to triangular in outline, not deeply cordate or with large ears, dentate, enlarging in the fruit when the veins and ears are much more marked. *Calyx* usually about half the length of the bracteoles, obsolete crenulate, gland dotted, three large glands at the base. *Corolla* opening fully, sulphur yellow with dark crimson patches at the base of the petals, about 2 inches across. *Stigmas* united, occasionally with bands of black glandular dots. *Capsule* ovate or oval, flattened at the top, with a short thick point, ending in a bristle usually 3-seldom 4-celled, trigonous in cross-section. *Seeds* 6–7, occasionally 8–10, in each cell, small rounded ovate, covered with very short yellow brown fuzz. *Wool* adhering loosely, fine, white and silky; staple

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Descriptions of the

GUJARAT
COTTONS.

$\frac{3}{4}$ -inch to 1 inch in length; seed-cotton generally yields 33–35 per cent. clean cotton.

Yield.

Habitat and Season.—This cotton is cultivated in Nawsari, Surat, Broach, and part of the Baroda districts and in the Rajpipla State. It grows on black clay soil; is sown in June, just before, or just after, the beginning of the monsoon rains, begins to flower in the end of October and to bear in the middle of January; it continues bearing for two months. In seasons of late and heavy rainfall picking may not begin until the end of February. A good crop will yield 400–500lbs. of seed-cotton per acre. The cotton is of high quality, and the “growths” of the best districts rank first among Indian cottons. With the exception of an admixture of *Goghari*, which occurs in a few districts, *Kahnami* cotton is pure. *Roji* plants occasionally find their way into the fields, but they are easily distinguished; and the cultivators remove them, even if left they do no harm, for *Roji* produces very few bolls in the first year and these not until after *Kahnami* cotton has been picked. I have never seen cottons of the *G. neglectum* or *G. roseum* type among Broach cottons.

The districts round Nawsari and Broach produce the best, and the district to the south-east of Baroda the worst, forms of *Kahnami* cotton. The difference in quality depends mainly upon the soil.

(2) *Goghari Cotton* is a distinct race of the *Kahnami* cotton, grown on both sides of the *Dhedar* river between Baroda and Broach, and also to some extent in the Rajpipla State. It requires a lighter soil than *Kahnami*, and grows on the loams or calcareous loams that occur at the junction of the *Kali* or black soil, with the *Goradu* or light soil of Gujarat.

Description.—The plant closely resembles *Kahnami*, and until the bolls form they cannot be distinguished. The following are the general points of difference:—

- (1) The whole plant is more robust than the ordinary Broach cotton; this is chiefly because the soil on which *Goghari* is grown, is better drained than the clay soils which yield *Kahnami*; when the two plants are grown together they are similar in habit.
- (2) The bolls are globose and larger than those of *Kahnami*. The segments of the capsule are very broad and usually do not recurve when the fruit is ripe.
- (3) The seeds are larger than those of *Kahnami*, are darker in colour and have more fuzz.
- (4) The wool adheres more firmly to the seeds, is whiter, crisper, coarser, and more abundant. The wool surrounding each seed separates readily from the wool of the others and does not ‘cling’ as in *Kahnami*. The percentage of clean to seed-cotton is high, usually 36–38 and in some samples 40 per cent.

Origin.—When I first met with *Goghari* I was disposed to regard it as a cross between *Kahnami* and *Roji* (the cotton of North Gujarat); it grew on loam soils at the junction of black soil with light soil, frequently assumed the tall habit of *Roji*, and—though it more nearly approached the value of *Kahnami*—the staple was intermediate in quality between that of the other cottons. I have altered this opinion and now believe that *Goghari* is not a hybrid between cottons of the *G. arboreum* and *G. herbaceum* groups, but a cross between two cottons of the *G. herbaceum* series, *vir. Wageria* and Broach *Deshi*. Its name indicates that it came to Broach from Gogha, a Kathiawar port near Bhavnagar, and its present good qualities are the results of the careful cultivation of this new race of cotton

G. 381.

Chief Cultivated Cottons. (T. H. Middleton.) GOSSYPIMUM.

GUJARAT
COTTONS.

which the Broach ryots found peculiarly adapted to certain soils. The *Goghari* plant shows no trace of *G. arboreum* descent; and it is so like *Kahnami*, that, except for the globose bolls and white but coarser fibre, I should have thought it was a race developed by selection from a purely *Deshi* ancestor. Since its first appearance (it has been known in Gujarat for at least 20 years), *Goghari* cotton seed has always been selected; it suits a soil on which *Kahnami* does not grow well, and as *Kahnami* is much the more common cotton and the two are mixed by ginneries, unless care had been taken to preserve the seed separate, *Goghari* would soon have been lost. A considerable number of cultivators regularly select their *Goghari* seed, but the majority content themselves with getting it from the money-lenders, and since the introduction of steam gins, seed so obtained has been very impure.

Fields of pure *Goghari* exist in some villages, but they are comparatively rare, and all the crops I have seen have been mixed. *Goghari* and *Kahnami* seem to cross readily. Plants intermediate between the two types are very common.

(3) *Gundi Goghari*.—A cotton known as *Gundi Goghari* is occasionally met with near Baroda. This plant has smaller and more numerous bolls than *Goghari* proper, and the cotton is better in quality. I believe it to be merely an intermediate form between *Goghari* and *Kahnami*.

(4) *Lalio Cotton* is a variety of *Kahnami* cultivated on loam soils in the Ahmedabad district. As it grows on a light soil it usually develops into a tall pyramidal bush, with narrower and more sinuate leaf-lobes than the type.* In other respects the plants are the same, and it is doubtful whether *Lalio* is even a variety of *Kahnami*.

The name *Lalio* is, in Kathiawar, applied to cottons of which the wool hangs down (saliva-like) when ripe, in distinction to *Wagria* cotton, the bolls of which remain closed, so that the cotton is not seen. Outside Kathiawar and the Ahmedabad district the name *Lalio* is not used. Although the same tall form is grown in the Nawsari district, it is there called "*Deshi*."

The most typical growths of '*Lalio*' I have examined, and those which differ most from ordinary Broach in habit and leaf are the cottons known to merchants as "*Ambli*" and "*Sakalia*" found growing on the Kathiawar coast near the port of Dholera.

Ambli was described by the merchant who sent me the seed as a high class Dholera, colour, staple and outturn good, and much resembling Broach. *Sakalia* is grown on lighter soils and is inferior in value, chiefly on account of the high percentage of leaf which the lint contains.

(5) *Deshi or Asul Deshi* (Indigenous country) cotton was formerly the variety most frequently grown in the southern States of Kathiawar, Bhavnagar, Palitana, Junagardh, &c. It has a fine silky staple, little inferior in quality to Broach, but, in spite of its value, it is yearly losing its popularity and is being replaced by the coarser but more productive *Kanvi*.

Description.—The botanical differences between the *Deshi* of Kathiawar and the *Deshi* of Broach are exceedingly slight. When grown under the same conditions the former is a smaller plant, with the narrower leaf-lobes and fewer hairs of *Ambli*; it is in fact a connecting link between ordinary Broach and the Dholera *Lalio*. It has the habit of the former and the foliage of the latter. In these three forms the bolls, wool, and seeds are alike as regards shape, silkiness and size; but the commercial value of the staple varies from place to place under the slightly different conditions of soil, climate, and cultivation.

(*The behaviour of cotton is an example of a general rule. Tap-rooted plants run far more to stem and leaf on light soils than on clay. *Tur* (*Cajanus indicus*) is another familiar illustration of this fact.)

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(6) *Kanvi* or *Kanpuri* cotton is grown all over Southern Kathiawar and, as just noted, it is rapidly ousting the *Deshi*.

This form is said to have come from the north of India within the last ten or fifteen years; hence the name *Kanpuri*. In general appearance it closely resembles the *Deshi*, it differs (1) in being more robust; (2) in having the lobes of the leaves broader and less sinuate than in Kathiawar *Deshi* and similar to the leaf-lobes of *Wagria*; (3) the bolls are frequently 4-celled and are globose.

Description.—The bolls, wool and seeds of *Kanpuri* closely resemble those of *Goghari*, the only difference being that the bolls of the former are smaller and smoother than those of the latter. *Kanpuri* is to Kathiawar *Deshi* what *Goghari* is to Broach *Deshi*. Commercially it is less valuable than *Goghari*, because the conditions under which cotton is cultivated in Kathiawar are inferior to those of Broach.

Origin.—In the face of the assertion that this cotton has come to Kathiawar from the north of India within recent years, its resemblance to the indigenous cottons of Gujarat is remarkable, and no less remarkable is the absence of any of the characteristics of the *G. neglectum* cottons commonly grown in Northern India. I have carefully examined every part of the plant for traces of its connection with the cottons of this family, but, excepting the larger seeds and coarser wool (which are not necessarily evidence of affinity), the only thing I have noticed is that the middle and two side ribs of the leaf of *Kanpuri* are more frequently furnished with glands than in Broach *Deshi*. The cottons of the *G. arboreum* group generally have the three ribs glandular. Gujarat cottons very rarely have a gland on more than one rib. Whilst traces of relationship with the cottons of the North-West are wanting, it is remarkable that in the one character in which *Kanpuri* differs most from *Deshi* (the globose bolls), we have the opposite of what might be looked for in a cross between Gujarat and *neglectum*-leaved cottons. The bolls of the latter are usually long, pointed ovate, and the bolls of the former are short ovate, with a very short obtuse point ending in a bristle. The only cotton I know of in Northern India, which at all resembles *Kanpuri*, is a variety described as Bengal *Desi* (No. 15). This cotton, like our Gujarat annuals, belongs to the *G. herbaceum* series, and this or some similar *G. herbaceum* cotton of the north may possibly, but I think improbably, have given rise to the *Kanpuri* of Kathiawar.

Mathia Cotton.—The narrow-leaved and white-flowered cotton, which is so common in Central and Northern India, has found its way into isolated spots in Kathiawar where it is known as *Mathia* from the resemblance of the leaves to those of *Math* (*Phaseolus aconitifolius*). The cotton is as yet of no commercial importance, but as it has found favour with the cultivators near Bhavnagar, and as it hybridises readily with *Kanpuri* (and presumably with *Deshi*) it will soon make its presence known. (Confer with remarks p. 13.)

(7) *Wagria* Cotton.—This is the common cotton of Northern Kathiawar. The name seems to indicate that it came to Kathiawar from *Wagad*, a district lying to the north of the Runn of Cutch. The most typical forms of *Wagria* are found in the north of Kathiawar, on the south shore of the Runn; southwards its character changes and it becomes very similar to the *Kanpuri* variety.

Description.—*Wagria* cotton is a small-branched bush, usually standing from 18 to 30 inches high, much less hairy than Broach *Deshi*; the young stems, petioles, &c., are moderately thickly covered with simple hairs; stellate hairs are large and numerous on the young leaves, few on older leaves which are almost glabrous and have a shining oily appearance. Stems, branches and petioles of a deeper red on the upper surfaces than in *Deshi*. Leaves 3–5-lobed, cordate, half segmented or less; lobes ovate to broad ovate, con-

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stricted at the base; the lobes of the leaves on the younger branches are broad, obtuse, and not constricted at the base. *Stipules* $\frac{1}{2}$ inch linear acuminate, those on peduncles unequal as in *Deshi*. *Bracteoles* less than half the length of the corolla, broadly ovate, cordate dentate or subentire, teeth shorter than they usually are in *Deshi*, spreading as the flower fades. (This spreading habit of the bracteoles is seen in all the annual cottons of Gujarat, but is most marked in *Wagria*, where they often begin to spread when the flower is opening.) *Flower* as in *Deshi*, but turning pink more rapidly on fading. *Bolls* smooth globose, mostly 3-celled, do not open fully when ripe, so that they are forced open by hand after harvesting the cotton; wool white, coarser than Broach; seeds medium, size 5–8 in cell, covered with yellow to brown velvet.

Habitat and Seasons.—The plant requires less moisture than the varieties described above. It takes eight months to ripen. I have grown *Wagria* cotton for three seasons and have obtained seed from five districts in Kathiawar. The characters above given are those of the more northerly growths. Seed from Botád, which is on the borders of the *Kanvi*-growing district, produced *Wagria* cotton that much resembled *Kanvi*.

Origin.—*Wagria* must be the cotton which Todaro describes as *G. herbaceum* var. *microcarpum* (Dict. Econ. Prod., Vol. IV., 27). I do not think that it is specifically distinct from our other Gujarat cottons, which, he says, are forms of *G. Wightianum*, but it differs more markedly from typical Broach *Deshi* than any of the varieties yet described. I consider *Wagria* like the more hirsute *Kahnami* to be descended from a *G. herbaceum* ancestor, and that present differences are due to the different climates in which the plants have been cultivated.

I further think that the crossing of *Wagria* with *Deshi* has produced the round-bolled, and coarser-fibred varieties known as *Kanpuri* and *Goghari*. The segments of the boll are much alike in all three cottons. In pure *Goghari* the segments of the boll seldom recurve in ripening, and the half open capsule which we find in this race is exactly midway (except in size) between the ripe bolls of *Kahnami* and *Wagria*.

(8) *Roji or Jaria Cotton*.—This is a perennial, cultivated upon light soils in northern Gujarat.

Description.—A tall, much-branched shrub, 6–8 feet high, it readily runs wild, and in hedge-rows assumes a climbing habit; young parts covered with stellate hairs, which fall off leaving the mature plant almost glabrous, a few long simple hairs scattered over the young stem, petioles, etc., plant covered with elliptical black glandular dots, which, on account of its glabrous character, are very distinct. *Stem* woody beneath, and cinereous, or with a brownish tinge, young parts herbaceous green and red where exposed to the sun. *Leaves* cordate, mostly 5-lobed, half segmented; lobes ovate acute to acuminate, narrower than the lobes of the leaf of *Kahnami*, somewhat constricted at the base; large extra lobe frequent in the sinus on either side of the middle lobe; margins not sinuate, leathery, dark green in colour, glands usually on three ribs. *Petioles* about as long as the leaf-blades thickened at the base. *Stipules* small, $\frac{1}{2}$ inch to $\frac{3}{4}$ inch falcate, those on peduncles are unequal. *Flowers* borne on secondary or tertiary branches, sometimes solitary, sometimes 2–3 on each branch. *Peduncles* extra axillary, trigonous short. *Bracteoles* toothed, sometimes entire, cordate with large ears, triangular to ovate acute, half as long as corolla or less. *Calyx* with glands marked at base, truncate or subcrenulate. *Corolla* large pale-yellow with purple centre, rapidly turning pink on fading. *Stigma* eglandular. *Bolls* mostly 3-celled, trigonous in cross-section, ovate acuminate, opening fully when ripe. *Seeds*, 5–7 in each

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cell, covered with greenish-gray fuzz; wool adhering firmly, white; staple poor, short, and harsh.

Habitat and Season.—This cotton is cultivated as a mixed crop, one row being sown between ten or twelve rows of some cereal. In the first season it yields little or no cotton; in the hot weather it is cut down to within one foot of the ground; in the second monsoon it grows luxuriantly and produces a full crop in the following hot season. The cotton of subsequent years is of coarser quality than that of the second, and the plant is usually rooted out at the end of the third or fourth season, but it is occasionally allowed to grow for six or seven years. When growing wild in hedge-rows the cotton turns yellow, and very short in the staple, the fuzz at the same time becomes long.

Origin.—*Roji* is markedly different from the annual cottons and does not seem to hybridise with them. I have never seen any plant that might be taken for a cross. It strongly resembles *G. arboreum*, the chief difference being a yellow flower and the absence of the marked reddish tinge possessed by this species.

Roji would appear to have become possessed of a yellow flower within the past 100 years, for when Hove was in Gujarat the perennial cotton, which he found being cultivated in precisely the same way in which *Roji* is cultivated now, had a red flower. Some of our best Gujarat cultivators are said to have come from the north of India in the 17th century, and it is possible that Hove's red-flowered cotton may have been brought from the north by them; a red-flowered cotton, which is described below, is cultivated in the Punjab at the present day. *Roji* is almost identical with a wild cotton found by Dr. Watt in Kathiawar, and another wild cotton sent from Marwar* to the Poona Farm where it was cultivated as *G. Wightianum*, *Tod.*, which it is not.

* [The admitted similarity of these wild plants surely points to their being a distinct species, but see Foot-note, page 17. Editor.]

CONCLUDING REMARKS ON GUJARAT COTTONS.

The above are all the varieties of indigenous cottons I have found cultivated in Gujarat.

In the local Gazetteers a number of names are given, and these are quoted at pages 63 and 64 of Vol. IV of the Dictionary of Economic Products. Some of these names I have not heard used; but I believe that all refer to one or other of the nine varieties described here, or to a foreign cotton.

The Editor of the Dictionary quoting the Broach Gazetteer mentions *Lalio*, *Jaria*, *Roji*, and *Narma*. I have not heard the name '*Lalio*' used by Broach cultivators. *Lalio* cotton is always called *Deshi* or *Kahnami* in this district. The name '*Lalio*' is used in Ahmedabad and Kathiawar. *Jaria* and *Roji* are the same. *Narma* is of several kinds. *G. barbadense* is the most common; *Kidney* cotton, *G. brasiliense*, and true *Narma*, *G. arboreum*, are comparatively rare.

Virangam is said to grow *Jatvoria*, this is a name I do not know, Virangam does grow *Wagria* and *Lalio*.

Bhalia cotton simply means the cotton of the Bhal country, a district at the head of the Gulf of Cambay. *Bhalia* includes the kinds above described as *Ambli* and *Sukalia*. *Wagria* has been already alluded to. The term *Lalio*, as used in Kathiawar, is given to no one growth of cotton, but to all varieties, the bolls of which open fully, as distinguished from *Wagria*, the bolls of which must be opened by hand.

The *Desai* cotton of Bhavnagar is *Deshi* or *Asul Deshi*. Bhavnagar also grows *Kanvi* or *Kanpuri*, and to a very limited extent *Mathia*, the same cotton as the *Varadi* of Khandesh.

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II.—COTTONS OF THE SOUTHERN MARATHA COUNTRY.

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(9) *Coompta Cotton*.—This cotton did not develop well in Baroda the plants were low-branched bushes, 12 inches to 18 inches high and closely resembled small plants of Broach *Deshi*. The seed was pure and all the cotton was of one variety.

Description.—Stems, petioles, &c., very hairy; stem herbaceous, much branched. *Leaves* cordate, 5-lobed, palmatifid; lobes ovate, markedly constricted at base; sinuses rising in a fold; middle lobe acute to acuminate, mucronate; hairs stellate. *Stipules* linear, acuminate $\frac{3}{4}$ inch, those on peduncles unequal. *Petioles* $\frac{3}{4}$ the length of the leaf-blades. *Peduncles* very short. Bracteoles small, dentate, or inciso-dentate, ovate. *Calyx* crenulate. *Corolla* twice as long as bracteoles, opening fully, yellow with deep-red patch at the base. *Capsules* small, 3-celled, ovate. Seeds with yellowish-gray velvet.

Origin.—*Coompta* cotton belongs to the *G. herbaceum* series and is closely allied to the annual cottons of Gujarat. As cultivated by me it showed no traces of admixture with other varieties, or of hybridisation with the Dharwar Saw-ginned or any other species of cotton.

(10) *Dharwar Saw-ginned Cotton*.—This variety is a form of *G. hirsutum*,—a species which will be described further on. The plants which grew at the farm were weak and puny, but showed no trace whatever of hybridisation with *G. herbaceum*.

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(11) *Tellapatti*.—Seed of this variety was received from Bellary and Kurnool. The seed appeared to be mixed, some being covered with a short gray fuzz and others being naked like the seeds of Bourbon cotton. I picked out the naked seeds from the others and planted them separately, but they produced identical plants and there was no trace of a 'Bourbon' hybrid. The *Tellapatti* of Kurnool is the same as that of Bellary, and the following description stands for both.

Description.—Low-branched bushes, much resembling small plants of Broach *Deshi*; stem, branches, petioles, leaf-ribs and peduncles villous. Young leaves covered with branched and stellate hairs; older leaves moderately hairy. *Stem* herbaceous, green. *Leaves* cordate, 3—5-lobed, palmatifid; lobes ovate acute, mucronate, constricted at the base; sinus rises up in a fold. *Petioles* from $\frac{1}{2}$ to $\frac{3}{4}$ the length of the leaf-blade. *Stipules* $\frac{3}{4}$ inch, linear, acuminate. Bracteoles small, united at the base, forming a cup for the flower, inciso-dentate, enlarging slightly in fruit. *Flowers* small, several together at the ends of secondary branches. *Boll* small, 3—4-celled, acute to acuminate. *Seeds*, 6—8 in cell, small rounded or ovate, almost or quite free from velvet. Wool adheres loosely to the seed; staple short, coarse.

Origin.—*Tellapatti*, on the whole, very closely resembles Broach *Deshi*, and there can be no doubt that like *Coompta* it belongs to the same stock. Apart from the small size and poverty of the crop (which was due to growth under unsuitable conditions) the most noticeable distinctions between Broach and Bellary cottons are, (1) the occasional naked seeds of the latter, and (2) that the older stems of *Tellapatti* are much more thickly covered with brown hairs than the stems of *Kahnahi*.

(12) *Uppam* from Tinnevely and Coimbatore, if not the same cotton as the above, is a closely allied race with seeds resembling those of Broach cotton and rounded bolls recalling those of *Goghari*. To distinguish between two varieties so similar to each other as *Tellapatti* and *Uppam*, it would be necessary to study them in their native districts.

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The seed of *Uppam* was mixed to a small extent with seeds of the *Nadam* variety.

Karungkanni from Tinnevely appears to be a poor and degenerate race of *Uppam*. The seeds were largely mixed with those of *Nadam*.

(13) *Nadam*.—Seed sent from Coimbatore.

Description.—A beautiful plant with dark-green foliage and deep-red stem and branches. In the bud and on the ribs and mesophyll of the youngest leaves there are numerous small neat stellate hairs, these fall off quickly; full-grown leaves have few hairs and old leaves are glabrous. *Glands* and glandular dots well marked all over the plant. *Stem* strong, erect; branches numerous ascending. *Leaves*, slightly to distinctly cordate, 5-lobed, palmatifid; lobes ovate-acuminate to ovate-pointed; margins not waved; sinus not bent up in a fold; extra lobe pretty common, blade as long as broad. Young leaves of a delicate green and old leaves of a dark and glossy green, three middle ribs of leaves usually gland dotted, in the bracts middle rib only dotted. *Petioles* as long as leaf-blades. *Stipules* falcate $\frac{3}{4}$ inch, those on peduncles unequal, but the inequality is less marked than in the *G. herbaceum* cottons above described. *Peduncles* jointed below the middle, borne on the secondary and tertiary branches. *Bracteoles* separate almost to the base, small, ovate to triangular, entire or toothed, enlarging slightly in the fruit, much like those of *Roji*. *Calyx* moderately large, truncate to crenulate, glands at the base marked. *Corolla* medium size, more than twice the length of the bracteoles, bright yellow with a purple patch at the base, pink on outside in bud and rapidly turning pink on passing maturity. *Stigma* eglandular, consists of 3–4 bands, often much twisted, usually projects about half an inch beyond the staminal tube. *Capsule*, 3–4-celled, elongate ovate with a short point. Seeds 6 to 7 in cell, medium size, thick; fuzz gray; wool white, short, firmly adhering to the seed.

Origin.—In habit, in the nearly glabrous character and in the colour of the stems and leaves *Nadam* is closely related to *G. arboreum*, the bracteoles and the fruit also bear a similarity to those of this species, but the leaves, though not sinuate, have the shape *Todaro* ascribes to *G. Wightianum*, and the flower is yellow. I suppose *Nadam* to be a hybrid with a strong strain of *G. arboreum*, the other parent being *G. herbaceum* or *G. indicum*.

Nadam is the *Roji* of Madras, there is a great resemblance between the two cottons, and it is quite likely that they may have descended from a common stock. *Nadam*, like *Roji*, is a perennial, it flowers and begins to bear about nine months after sowing.

(14) *Yerrapatti*.—Seed received from Kistna and Kurnool. This variety is distinct from both *Tellapatti* and *Nadam*, but resembles the latter more than the former.

Description.—Pyramidal bushes with grayish stems and branches, young parts bearing both simple and stellate hairs; old parts almost glabrous. *Leaves* cordate, 5-lobed; middle lobe ovate acuminate, other lobes ovate, usually three ribs of leaf glandular (in *Tellapatti* one only). *Stipules* as in *Nadam*. *Flowering branches* with one to two flowers. *Bracteoles* small, ovate, united at base, slightly dentate, half the length of flower, enlarging greatly in fruit and becoming nearly as long as the boll. *Flowers* yellow with purple centre, small, convolute. *Bolls* medium size, 3–4-celled, triangular acuminate. *Seeds* small greenish; fuzz, ovate; wool short in staple, silky with a reddish tinge.

Origin.—*Yerrapatti* differs from *Nadam*: its nearest Madras relative as follows:—

- (1) The stems and branches are not markedly red.
- (2) The foliage is paler green.

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- (3) Stellate hairs are more numerous both on the young and the old leaves.
- (4) The bracteoles enlarge much more in the fruit.
- (5) Calyx very shallow and cup-shaped.
- (6) Bolls are long triangular, acuminate.
- (7) Seeds are smaller and covered with a greenish fuzz.
- (8) Cotton has a reddish tinge.

IV.—BENGAL COTTONS.

(15) *Desi* from Chupra, Sarun.

Description.—A robust pyramidal bush standing 3–6 feet high; stem erect, much branched; branches ascending, woody below; younger parts and petioles, leaf-ribs, &c., villous, but less hairy than in Broach cotton; reddish below; young parts green. *Leaves* when young thickly felted with delicate branched stellate hairs; full-grown leaves less hairy than in Broach, and old leaves almost glabrous, dark green in colour and leathery in texture; base cordate, palmatifid, sometimes almost palmatifid, 5–7-lobed; lobes ovate (narrower than in Broach) acuminate or acute, constricted at the base; sinus rounded, with rarely an extra lobe; midrib glandular (side ribs very occasionally have glands). *Petioles* vary, usually, a little shorter than leaf-blades. *Stipules* linear acuminate, falcate when drying. *Flowers* borne on secondary or tertiary branches, several on each branch. *Peduncles* short. *Bracteoles* medium to large, deeply cordate, broad ovate, lacinate; ears large, not enlarging much in fruit. (The bracteoles are like those figured in Todaro's Monograph as those of *G. herbaceum*.) *Calyx* crenulate frequently with two teeth. *Corolla* twice as long as bracteoles or less, pale-yellow with red patches at the base. *Stigma* 3 flat united bands, with double rows of black glandular dots between each. *Capsule* elliptical to globose with a short point, small, 3–4-celled; cells 3–5-seeded. *Seeds* small with a very short, or with no beak on the hilum; fuzz thick, white on surface, greenish underneath; wool short, weak and scanty.

Origin.—This *Desi* cotton of Sarun is closely allied to the family to which the Gujarat annual cottons belong. It differs from Broach mainly in the following points :—

- (1) The stem and branches are stronger, so that the bush is more regularly pyramidal.
- (2) The leaves are dark-green and less hairy.
- (3) The bracteoles are larger, thinner and more deeply gashed.
- (4) The bolls are smaller and have fewer seeds in each cell.
- (5) The beak on the hilum is much reduced.

Desi cotton resembles closely the *G. herbaceum* var. *microcarpum* of Todaro, but the extra lobe in the leaf and the narrow leaf-lobe, which is marked in some specimens, point to a trace of *G. aboreum* in its ancestry.

Disilla cotton seed sent to me from Sewan, Sarun and Jethayi from Gopalgunj, Sarun, produced plants identical with the above.

(16) *Bhogila or Bhogola Cotton*.—Four samples of seed bearing this name were sent to me, two of these produced the white-flowered cotton described as *Nurdki* (No. 20), the other two from Sewan and Gopalgunj in the Sarun district produced the plant described below.

Description.—Pyramidal bushes resembling in general appearance the *Desi* of Chupra. Stem red; young parts less hairy than in last; simple hairs on petioles, ribs, &c.; youngest leaves covered with stellate hairs

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which disappear leaving the old leaves almost glabrous; stellate hairs small, neat, and regular as in *Nadam* (not as in Broach *Deshi*). *Leaves* cordate, mostly 5-lobed, half segmented; lobes long, ovate, pointed, scarcely constricted at the base; sinus rounded, extra lobe occasionally; margins not sinuate; three ribs usually glandular. *Stipules* short, falcate. *Flower* 1—3 on secondary or tertiary branches. *Peduncles* extra axillary. *Bracteoles* deeply cordate; ears large, more triangular than in *Desi*, entire or with few teeth, not enlarging much in fruit; veins distinctly marked. *Calyx* with long teeth. *Corolla* as in *Desi*, turning colour rapidly on withering. *Bolls* ovate, pointed, much like those of *G. arboreum*, mostly 3-celled; cells 6—8-seeded. Seeds very small, short beak on hilum; fuzz dark-gray; wool white, firmly adhering to seed, scanty, poor staple.

Origin.—*Bhoglla* cotton seems to hybridise with *Desi*, for several doubtful and intermediate forms grew among the *Bhogalla* plants; the seed, too, was mixed with *Desi* seed, especially that from Gopalgunj.

Typical *Bhoglla* differs from *Desi* in the following respects:—

- (1) The base of the leaf is less markedly cordate in the *Bhoglla* variety, the bases of the lobes are scarcely at all constricted and three ribs are usually glandular.
- (2) The bracteoles are coarser than in *Desi*, are more triangular and are entire or sub-entire.
- (3) The peduncles are extra-axillary.
- (4) The flowers are larger.
- (5) The calyx is toothed.
- (6) The bolls are ovate, pointed, not globose as in *Desi*.
- (7) There are 6—8 seeds in a cell, not 3—5 as in *Desi*.

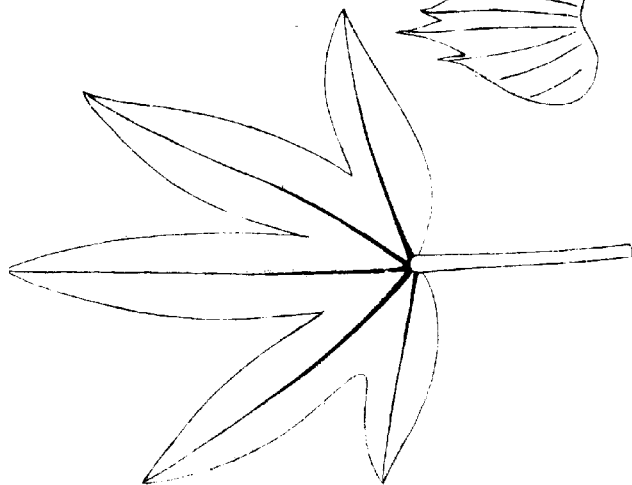
Bhoglla cotton presents many points of resemblance to the *Roji* of Gujarat and the *Nadam* of Madras, and is the Bengal representative of the cross *arboreum-herbaceum* cottons.

(17) *Kherdiya*.—From Lohardagga* under the name of *Kapas*, and from another district under the name of *Kherdiya* I received the seed of the yellow-flowered and neglectum-leaved cotton described below.

Description.—Small little-branched bushes, 18 inches to 2 feet high, young parts hairy; hairs stellate, smaller than those of Broach cotton and larger than in *Nadam*; old leaves, &c., retaining a moderate number of hairs. *Stem* reddish, woody. *Leaves* cordate, palmatipartite, 5—7-lobed; lobes lanceolate, acute; sinus rounded with sometimes an extra lobe; margins never sinuate; ribs eglandular. Bract leaves 3-lobed, rarely entire. *Petioles* shorter than leaf-blades. *Stipules* $\frac{1}{2}$ inch broadly linear, those on peduncles large, broad and unequal. *Flowers* mostly two together on tertiary branches. *Bracteoles* sub-entire, more than half the length of the corolla, divided almost to base, narrow triangular, acute, not enlarging much in fruit. *Calyx* toothed, with marked glands at base. *Corolla* medium size, yellow with deep-purple patch at base, rapidly turning pink on withering. *Boll* long pointed, ovate acuminate, 3—4-celled. *Seeds* small; beak very short; fuzz brownish or greenish.

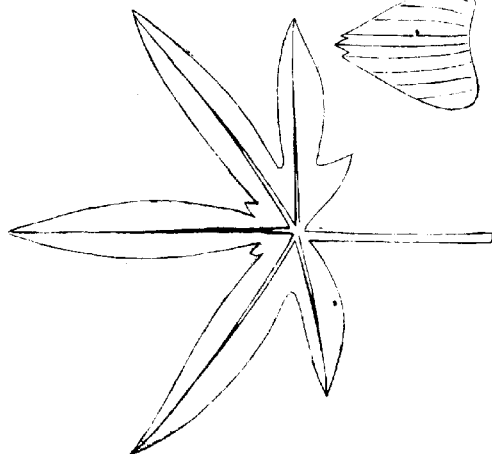
* The Deputy Commissioner of Lohardagga in forwarding Cotton-seeds from his district remarked that three kinds were grown:—(1) *Kapas*, with a yellow flower and a middling staple. This was a common sort, the two remaining kinds were occasionally grown; (2) *Chandapara* with a red flower and a good staple; (3) *Bhoglla* *Kapas* with a white flower and a good staple.

Samples of all were sent me, but with the second variety a mistake must have been made, for all the plants had yellow or white flowers, none were red. The red-flowered cotton is probably allied to the *Narma* of Shahpur, No. 25. The other varieties are described as *Kherdiya*, No. 17, and *Nurdi*, No. 20.



Bractlet from
1/2 grown boll of
Counpore Cotton

Leaf of Khordya
Cotton



Bractlet of
Khordya Cotton

Leaf of Khordya
Cotton

Chief Cultivated Cottons. (T. H. Middleton.) GOSSYPIMUM

BENGAL
COTTONS.

Origin.—This cotton is different from any of those hitherto described. It is Todaro's *G. neglectum*.

Forming connecting links between *Kherdya* and *Desi*, there are two Bengal cottons which came to me with the names *Borea* and *Burdya*.

(18) *Borea* cotton is very similar to the last, it differs from it as follows:—

- (1) The whole plant is larger and more robust.
- (2) The bracteoles are broadly ovate, toothed and nearly as long as the bolls; in *Kherdya* they are narrow, triangular, and half as long as the bolls.
- (3) The bolls are much shorter than those of *Kherdya*.

The cotton produced by this plant was said by the sender of the seed to be of very good quality.

(19) *Burdya* cotton is a step nearer *Desi* than the last, but is still "*neglectum*" in most of its characters. It differs from *Kherdya*—

- (1) in being larger and more robust;
- (2) in having the lobes of the leaves broader.

The cotton produced by this plant was said to be of moderate quality.

(20) *Nurdki*.—This cotton was sent to me from Lohardagga under the name of *Bhogla* and from the office of the Director of Agriculture, Bengal, with *Bhogla* written in English on the parcel, and *Nurdki* written in Bengali inside the parcel. As an entirely different plant was sent to me from Sarun under the name of *Bhogla*, I adopt the name *Nurdki* for the white-flowered species described here.

Description.—Small erect plants with palmatipartite leaves and white flowers. Stems brown and woody, sparsely covered with simple hairs. Young parts covered with numerous minute stellate and simple hairs; old leaves with a few stellate hairs on both surfaces, and some simple hairs on the ribs, petioles, &c. Leaves cordate, palmatipartite to palmatisect, 5–7-lobed; lobes linear, lanceolate, acute; sinus broad; extra lobe rare; margins never sinuate. Petioles shorter than leaf-blades. Stipules small. Flowers on secondary branches; peduncles short. Bracteoles entire, or sometimes dentate, narrow, ovate, half length of corolla, enlarging somewhat in the fruit. Calyx large accrescent, forming a wide shallow cup when the corolla fades, crenulate or sub-dentate nearly white, covered with black dots; glands at base large. Corolla small, about $1\frac{1}{2}$ inches across, convolute, pale yellow-white in the bud, whitish when open, but very quickly fades pink, purple patches at base. Stigmas eglandular. Capsule ovate acuminate, or ovate acute, about $1\frac{1}{2}$ inches long, 3-celled. Seeds, 5–6 in cell, medium to large, ovate with a beak, but not the long point of *Katil Belati*; fuzz greenish-brown; wool scanty, finer than in *Varadi* but not so white, staple poor.

Origin.—Except for the colour of the flower *Nurdki* closely resembles *Kherdya*, and it is possibly a cross between *G. neglectum* and *G. roseum*.

Malgacha.—Under this name the seed of what was termed a "very good" cotton was sent to me from Bengal. It proved to be *G. hirsutum*, or, as it is usually called in India, "Upland Georgian Cotton." This and several other acclimatised 'Americans,' have been grown in small plots at the College Farm, and have done very much better than any of the freshly imported varieties which were planted beside them. Seed got from America produced puny plants not worthy of the name 'bush'; from the acclimatised seed, on the other hand, we raised strong and vigorous plants. This is an instance of the way in which cotton may alter its character under new conditions. Few plants suffer more at first from a change of climate; but, given time, it will alter its habits and adapt itself

GOSYPIUM.

Descriptions of the

CENTRAL
PROVINCES'
COTTONS.

to new circumstances. Unfortunately for India one of the first variations which exotic cottons undergo when brought to the country, is a change (and always for the worse) in the staple.

V.—COTTONS OF THE CENTRAL PROVINCES, BERAR, AND KHANDESH.

(21) *Nagpore Cotton, Variety A.*—Seed of this plant was sent to me from the Nagpore Farm, from Khandwa and from Khangaum.

Description.—Erect little-branched bushes, standing from 2½ to 4 feet high; young parts hairy; old, nearly glabrous; ribs, etc., furnished with simple, the leaves with small, stellate hairs. *Leaves* slightly cordate, palmatifid 3–7, mostly 3-lobed; lobes ovate acute, slightly constricted at the base; sinus frequently rises in a fold; occasionally there is an extra lobe in the sinus; midrib usually glandular. *Stipules* small, falcate; those on peduncles unequal. *Flowers* 2 or 3 on secondary or tertiary branches on short peduncles. *Bracteoles* small ovate, or sometimes almost triangular, sub-dentate, not enlarging much in fruit. *Corolla* twice the length of the bracteoles, large, petals markedly oblique, yellow with a deep-purple patch at the base. *Stigmas* cleft. *Capsules*, 3–5-celled, frequently 4-celled, long ovate acuminate, about 1½ inches long. *Seeds*, 7–8 in cell, small to medium size; fuzz brownish gray; cotton white and silky.

(22) *Nagpore Cotton, Variety B.*—A second and very similar cotton grew along with Variety A. It differs as follows:—

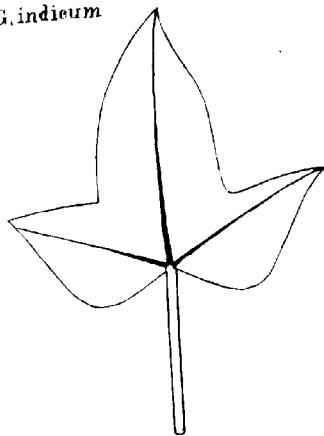
- (1) It matures later.
- (2) The midrib of the leaf is eglandular.
- (3) The bracteoles are larger, more delicate and usually dentate.
- (4) The flowers are very large, 3 inches—3½ inches across.
- (5) The bolls are ovate and abruptly acuminate; whereas the bolls in the last variety are conical and pointed.

I have only met with the second variety among plants raised from Nagpore Farm seed, but the other has been sent to me from Nagpore, from Khangaum in the Berars, and from Khandwa in the Central Provinces. The merchant who supplied me with seed from the two last-named districts wrote of the Khangaum sample as follows:—"This seed is from cotton that is grown in the Ghât or hilly districts, it possesses a good staple, is silky, and commands a high price; but the outturn of ginned cotton as compared to seed is small, and, as the price does not make up this difference, there are signs of this cotton dying out of cultivation." Of the Khandwa variety which was called "*Gowrani*" (a word which, I believe, means local), he wrote:—"It is of good staple and colour; but the outturn of cleaned cotton being poor, there is danger of this cotton dying out of cultivation, already the seed is being mixed and set with seed giving a larger outturn, and the probability is that *Gowrani* cotton will die out.

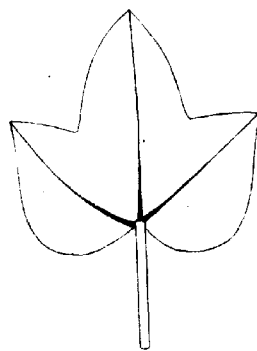
Neither the Khangaum nor the Khandwa cotton was quite pure, the first contained a few, and the second a considerable, number of the neglectum-leaved plants described below.

Origin.—The two forms, Nagpore A and Nagpore B, are now grown in the Central Provinces under the name of *Bani*, but I suspect that formerly the name *Bani* was restricted to the latter and that the "A" variety was known as *Jari*. I believe Variety B to be the last remaining representative of what was once an important cultivated race in Central and probably in Northern India and that it is the plant Todaro refers to as *G. indicum hamk*, vide Dictionary of Economic Products, Vol. IV, p. 29. The "A" variety is probably the result of a cross between the species *G. indicum* and *G. arboreum*. A degenerate form of this cross, mixed with the cotton next described, is the growth now known as *Jari* in the Central Provinces.

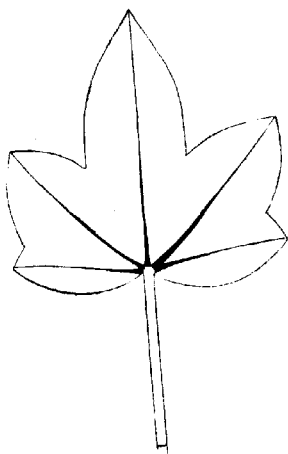
G. indicum



a Leaf of Bani Cotton



Leaf of Bani Cotton



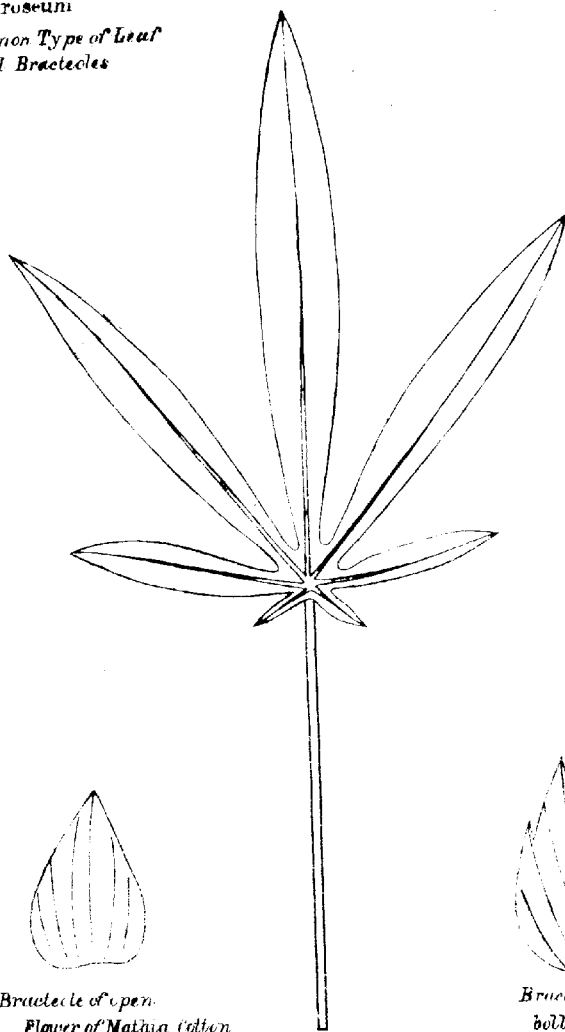
a Leaf of
Naggore form B (Bani) Cotton



Bractlet
from open flower of
Bani Cotton

XG. roseum

*common Type of Leaf
and Bracteoles*



*Bracteole of open
Flower of Natcha Cotton*



*Bracteole from ^{3/4} open
boll Nimari Cotton*

Leaf of

Chief Cultivated Cottons. (T. H. Middleton.) GOSSYPIUM.

(23) *Varadi Cotton, Katil Belati Cotton, Nimari Cotton*.—These three cottons may be described together. All of them are mixed growths. The predominant plant is a white-flowered species (*G. roseum*, *Tod.*) with which there are a number of the yellow-flowered and "neglectum-leaved" plants described as *Kherdya** (No. 16) and a few like the Nagpore Cotton Variety A (No. 21).

CENTRAL PROVINCES' COTTONS.

Varadi is the common cotton of Khandesh, the seed I grew came from Bhosawal and the sender writing of it said :— "This seed produces a short staple style of cotton, very white in colour, and the outturn of ginned cotton as compared to the seed is good."

Katil Belati came from Akote in the Berars, it was said to give over 50 per cent. of clean cotton, to ripen very early and to be most profitable to the ryots who gave it its name on account of the length of the beak on the hilum. These remarks I found applicable to white-flowered cotton, the chief component of *Katil Belati*, but not to the small yellow-flowered plant.

Nimari is the cotton of Nimar, the district of the Central Provinces which borders on Khandesh. The seed came from the Nagpore Farms; it contained a larger admixture of yellow-flowered plants than *Katil Belati*, and the white-flowered plant was smaller, and had a less markedly beaked seed, but was otherwise the same.

The following is a description of the white-flowered cotton, of which *Varadi*, *Katil Belati*, and *Nimari* chiefly consist† :—

Description.—Erect pyramidal bushes, 2 to 4½ feet high, lateral branches spreading; young parts covered with hair; simple hairs short and few on petioles, &c.; stellate hairs numerous all over young leaves, these hairs quickly fall off and the plants become almost glabrous. *Stem* dark, red below, greenish above, woody. *Leaves* cordate palmatipartite to palmatisect, 5–7-lobed, upper leaves 3-lobed, lobes lanceolate acute; margins not sinuate, sinuses broad, very seldom folded, extra lobe in sinus common, dark-green and leathery in texture, veins light-green standing out in marked contrast to the dark leaves, midrib always, and side ribs usually, glandular. *Stipules* linear, those on peduncles smaller than in the herbaceous cottons. *Flowers* borne on secondary or tertiary branches, 3–4 on each branch. *Bracteoles* large, ovate, deeply cordate with large bent ears, enlarging in fruit. *Calyx* sub-crenulate, with glands at the base marked. *Corolla* small, 1½ inches across, white with deep-purple patch at base, opening fully. *Stigma* eglandular. *Bolls* numerous, large, 3–4-celled, ovate with a sharp point. *Seeds* 6–7 in cells; hilum with long sharp beak, large and flattened, greenish fuzz. *Floss* white and abundant, but coarse and woolly; staple short.

Origin.—This cotton closely resembles the *Nurdki* of Bengal, but is a larger, more robust plant, with bigger bracteoles, a smaller calyx and corolla and larger bolls and seeds; it is a cultivated form of *Todaro's* species *G. roseum*. *Nurdki*, except for the flowers, is nearer his *G. neglectum*, it is either a cross between these species, or a degenerate race of the former.

* This is, I think, the cotton named "*Houri*" which is mentioned on page 89 of the Dict. Econ. Prod., Vol. IV.

† Compare page 4.

‡ The description is of *Mathia* from Bhavnagar, the strongest and apparently the most typical of the white-flowered cottons of the plains which I have examined; in *Nimari* the sinus of the leaf is more often folded, the leaves are not so dark-green in colour, the ears of the bracteoles are somewhat smaller than in *Mathia*, and there are deep depressions at the apex of each segment of the boll.

GOSSYPIMUM.

Descriptions of the

PANJAB
COTTONS.

White-flowered cotton is a dangerous rival to finer varieties. By nature it is made to supplant. When brought to a new district, instead of pining as most exiled cottons do, it develops all its best properties, grows robust, matures early, is prolific and so wins the favour of the cultivators; once established, it begins to degenerate, joins company with the worst of the native varieties and forms the mixed growths that constitute the bulk of the 'Bengals' of commerce.

The *Mathia* of Bhavnagar* and the *Katil Belati* of Akote are examples of what white-flowered cotton is when it appears in a new district, *Varadi* is a form on the decline, and *Nurdki* appears to have fallen low even among 'Bengals.'

VI.—PANJAB COTTONS.

Through the Director of Agriculture, I obtained six varieties from this Province. Three of these were from Shahpur district, two from Amballa, and one from Rawalpindi.

Of the Amballa cottons one had yellow floss; the seeds were those of an American cotton, but, as they refused to germinate, I could not determine the species. The other Amballa cotton was the same as the plant I have described as *Nurdki* (page 11) and mixed with it were a few yellow-flowered cottons like those of Rawalpindi, but with the leaf-lobes deeper cut.

(24) *Rawalpindi Cotton*.—Low-branched bushes, stems and petioles moderately hairy, but leaves, except youngest buds, almost glabrous; hairs stellate. *Leaves* slightly cordate, palmatifid, 5-lobed; lobes constricted at base; sinus acute or rounded without an extra lobe. *Petioles* as long as leaf-blades. *Stipules* linear, those on peduncles unequal. *Bracteoles* triangular, entire acute. *Corolla* twice as long as bracteoles, moderately large. *Bolls*, 3-4-celled, acuminate. *Seeds*, medium size, flattened ovate; beak on hilum short, covered with a brownish fuzz; staple short and poor.

Origin.—This variety seems to be more nearly related to *Bani* than to any other cultivated cotton.

*(25) *Narma*.—The first parcel of *Narma* seed received from the Panjab in 1892 was very impure, and most of the plants grown from it bore yellow and white flowers; in 1894 I got a fresh supply of fairly pure seed, from which the plants described below were raised.

Description.—Pyramidal, little-branched bushes; stems, petioles, peduncles, bracteole and veins of leaves of a reddish purple colour; stems and petioles with short simple hairs; youngest leaves pubescent; hairs stellate; old leaves almost glabrous. *Leaves* slightly cordate, palmatifid or palmatifid, 5-lobed; lobes ovate acuminate mucronate; middle lobes constricted at base; margins not waved; sinus of grown leaves does not rise in a fold, but frequently has an extra lobe; midrib eglandular. *Stipules* linear, falcate; those on peduncles unequal. *Flowers* two to three on short lateral branches. *Peduncles* very short, as long as bracteoles. *Bracteoles*

* With the cottons from the Shahpur district the following notes were sent by the Deputy Commissioner:—

- " 1. *Narma Cotton*.—Red flower, small seed and pod, cleaned cotton softer than other varieties in the country.
- " 2. *Bagar Cotton*, also known as *Watni Cotton*.—Seed small, of whitish colour, yellow flower, cleaned cotton not very soft, commonly cultivated in the Shahpur district.
- " 3. *Bajwara Cotton*.—Seed rather large and of a greenish colour, red flower, cleaned cotton soft, produces less cleaned cotton than any other varieties.

Chief Cultivated Cottons, (T. H. Middleton.) GOSSYPIUM.

PUNJAB
COTTONS.

ovate acute, entire, or slightly dentate, deeply cordate, separate to the base of the ears, ears large. *Calyx* reddish, crenulate; glands at base. *Corolla* pink with deep-purple patch at base, or deep-red in colour, small, opening fully $1\frac{1}{2}$ inches across, slightly longer than the bracteoles. *Stigma* 3-fid, eglandular, but with brown lines between the stigmatic bands. *Capsules* small, 3-4-celled, ovate acuminate, as long as, or sometimes shorter than the bracteoles which enlarge considerably in the fruit. *Seeds*, 8-9 in cell, small rounded; beak on hilum very short; fuzz brown; staple very short but silky.

Origin.—The purple tint of the petioles, veins, bracteoles and bolls as well as the red flower, makes *Narma* easily distinguished from any other cultivated cotton. In its colouring it closely resembles *G. arboreum*, and it is probably a hybrid between this species and *G. indicum*.

Bajwara.—Of the *Bajwara* variety I grew specimens in 1892 and again in 1894. The former were identical, or almost identical, with *Narma*, the only difference I noticed was that the bracteoles were smaller, and that the corolla was more uniformly red; like *Narma* the *Bajwara* cotton of 1892 was mixed with yellow-flowered plants. The sample of *Bajwara* seed sent me in 1894 produced *G. hirsutum*, like the *Malgacha* of Bengal, and I think that it is to *G. hirsutum* that the name must be applied in the Panjab. The Deputy Commissioner of Shahpur described the flower as red and the seeds as large and green, this description of the seed corresponds with the seed of the American variety, not with that of the other, and though the flower of *G. hirsutum* is pale-yellow when open, it quickly turns a reddish pink when past maturity.

(26) *Bagar or Watni Cotton*.—A mixed crop grew from the seed sent under this name. The predominant plant was the yellow-flowered variety described above as Rawalpindi cotton. With it were (a) a plant with yellow flowers and palmatifid leaves, like the *Kheriya* of Bengal, (b) a few plants of *Narma*, and (c) a variety with white flowers and palmatifid leaves which is described below.

Description.—Plants small, erect; stems little branched; hairs stellate, very small and few except on buds. *Leaves* palmatifid, mostly 5-lobed; lobes ovate acute, constricted at the base. *Stipules* on the peduncles very small. *Bracteoles* small, ovate acute or acuminate. *Corolla* white, small, $1\frac{1}{2}$ inches across, nearly twice as long as bracteoles. *Capsules* ovate pointed.

Origin.—This cotton is distinguished from the other white-flowered varieties by having palmatifid, not palmatifid, leaves, and by the small bracteoles.

Except in the colour of the flowers the three Panjab cottons,—the white-flowered, the red-flowered *Narma*, and the yellow-flowered Rawalpindi—are much alike, the red-flowered plant is a tolerably pure member of the *arboreum* group and the white and yellow-flowered races are possibly crosses with *G. roseum* and *G. indicum*, respectively.

VII.—COTTONS OF THE NORTH-WEST PROVINCES.

I received two samples of cotton-seed from the North-West. The first from the Saharunpore gardens was labelled "Country cotton." It proved to be a mixture of four varieties already described. The majority of the plants had yellow flowers and palmatifid leaves like Rawalpindi cotton, but were more robust in habit, the others had yellow flowers with palmatifid leaves, white flowers with palmatifid leaves and white flowers with palmatifid leaves. The other cotton came from the Cawnpore Farm; it was a variety of Todaro's *G. neglectum* free from admixture.

BOSSYPIMUM.

Descriptions of the

N.W. PRO-
VINCES'
COTTONS.(27) *Cawnpore Cotton.*

Description.—A pyramidal, little branched bush, 2' 6"—3' high; branches thin ascending. *Stems*, petioles, &c., reddish in colour covered with short simple hairs. *Leaves* palmatipartite, 5—7-lobed, lobes lanceolate, mucronate, extra lobe in sinus common, young hairs pubescent with both simple and stellate hairs, old leaves with a moderate number of hairs, fewer than in Broach cotton, more than in *Varadi*, midrib almost always eglandular. *Stipules* $\frac{3}{4}$ " linear. Those on the peduncles markedly unequal. *Flowers* very numerous, 3—5 on short peduncles, usually on secondary, occasionally on tertiary branches. *Bracteoles* medium sized, elongate ovate, deeply toothed, not enlarging much in the fruit. *Calyx* small, sub-crenulate with 3 glands at the base. *Corolla* $1\frac{1}{2}$ times length of bracteoles, bright-yellow with a deep-purple patch at the base, $2\frac{1}{2}$ "—3" in diameter, rapidly turning pink on fading. *Capsules* mostly 3-celled, ovate sub-acuminate with a short sharp point, from 1"—1 $\frac{1}{2}$ " long, slightly longer than the bracteoles. *Seeds* 5—7 in cell, small to medium in size, ovoid with a marked beak on the hilum, fuzz very short, dark ashy grey, cotton firmly adhering to the seed, staple short, floss soft and moderately silky.

This cotton is nearly related to the *Burdya* cotton of Bengal and is possibly identical with it.

VIII.—RAJPUTANA COTTON.*

(28) *Jeypore Cotton, Variety A.*

(28) *Description.*—Tall slender bushes, 4—5 feet high; stems, petioles, &c., pubescent; young leaves thickly felted with large stellate hairs; old leaves nearly glabrous. *Stem* more woody than in Broach, strong, erect; branches few. *Leaves* slightly to obsolete cordate, palmatifid, mostly 5-lobed; upper leaves 3-lobed; lobes narrow, ovate acuminate; margins ciliate but not sinuate; sinus rounded or folded, extra lobe frequent in the sinus, midrib generally eglandular. *Petioles* $\frac{3}{4}$ " as long as the leaf-blade. *Stipules* $\frac{3}{4}$ " inch linear. *Flowers* not numerous, usually on the secondary branches. *Bracteoles* roughly triangular, slightly to deeply dentate, soft and hirsute when young, united at base, large and enlarging in the fruit. *Calyx* crenulate, markedly gland-dotted with large glands at the base. *Corolla* small, about as long as the bracteoles, very pale-yellow or white with a purple base, rapidly turning pink on passing maturity, convolute. *Capsules* long, ovate acuminate or elliptical acuminate, 3—4-celled; cells 7—10-seeded. *Seeds* medium size, ovate with sharp beak on hilum; fuzz very short, brownish or whitish brown; wool white, moderately silky but short stapled.

(29) *Jeypore Cotton, Variety B*, differs only from "A" in the leaves which are cordate, palmatifid, 5—7-lobed; lobes lanceolate, acute, extra lobe in sinus; gland usually on the midrib. Petioles half the length of the leaf-blades.

Origin.—The Jeypore cottons appear to have originated in a cross between *G. herbaceum* and *G. roseum*. In habit, in the shape of the leaves, and in the flowers Variety B of the Jeypore cotton resembles *G. roseum*, it differs in being more hairy, in the shape of the bolls and in the seed; the "A" variety differs also from most white-flowered races, in the leaves, which resemble those of *G. herbaceum*. The foliage of Jeypore cotton is paler than that of the white-flowered tribe, it resembles the soft mossy green colour of the Gujarat cottons.

* In forwarding me a sample of cotton-seed from Jeypore the sender remarked that there was only one variety grown in the neighbourhood, and that it received no special vernacular name other than "*Kapas*". Upon growing it, however, I found that Jeypore Cotton was a mixture of two closely related varieties.

Chief Cultivated Cottons. (T. H. Middleton.) GOSSYPIMUM.

(30) **Wild Cotton from Marwar.**—I examined this cotton at the Poona Farm. Seed had been obtained from the Forest Superintendent of Marwar.

Description.—Much-branched bushes, $2\frac{1}{2}$ – $3\frac{1}{2}$ feet high; branches weak and spreading, probably a climber in the jungle. Young stems, petioles, &c., covered with long simple hairs; young leaves covered with stellate hairs, but less thickly than in Broach cotton; a few simple hairs. Stem red and woody. Leaves cordate, half or less than half segmented, 3–5-lobed; lobes ovate acute, mucronate, constricted at base; lobes on bract leaves obtuse short, not constricted at base; extra lobe in sinus occasionally. Petioles half the length of the leaf-blades. Stipules linear, those on peduncles unequal. Bracteoles ovate dentate united at base; veins marked. Calyx crenulate. Corolla small, $1\frac{1}{2}$ inches across, yellow with purple base. Capsules mostly ovate acuminate but various, some almost globose, 3–4-celled; cells 5–7-seeded; seeds moderately large with greenish brown fuzz; lint firmly attached to seed, white, but short, coarse, and woolly.

Origin.—This wild cotton was being grown under the name of *G. Wightianum*, Tod., it was not that species, however, and I doubt its being a wild plant at all. A suspicious circumstance was that, among the others, there were a few plants of *G. neglectum*, a mixture which suggests that the “gin” rather than the jungle was the source of the seed.*

In every respect the Marwar plant resembled the *Roji* of Gujarat, and it is closely allied to, or identical with, *Roji*. *Roji* very often escapes and grows wild in hedges and thickets.

The *Wild Cotton* of Kathiawar is almost identical with the plant growing at Poona. The simple hairs on the stems and petioles are shorter, the corolla is larger, the bolls are usually more pointed, and the wool has a tawny tinge; with these exceptions I can find no difference between the two.

IX.—SIND AND PERSIAN COTTONS.

(31) **Two Sind Cottons.**—Cotton seed obtained from Hyderabad Sind producing plants of two varieties, the one was a white-flowered form with palmatifid leaves resembling the *Nurdki* of Bengal, the other is described here.

Description.—Stems brownish covered with short scattered simple hairs. Leaves slightly cordate, palmatifid, 3–5-lobed; lobes ovate, constricted at the base, generally mucronate; margins not sinuate; extra lobe in sinus common; midribs, and occasionally the sideribs, glandular; young leaves pubescent; hairs both simple and stellate; old leaves nearly glabrous, hard and leathery. Stipules small and linear. Petioles $\frac{2}{3}$ as long as leaf-blade. Flowers numerous, 3–5 on secondary or tertiary branches. Peduncles shorter than the bracteoles, extra axillary. Bracteoles large and enlarging considerably in the fruit, sub-dentate or entire, ovate, not markedly cordate. Calyx pale, wide and shallow, sub-crenulate with large glands at the base. Corolla pale-yellow with purple patches nearly twice as long as bracteoles. Stigma eglandular, slightly 3-fid at the apex as in *G. arboreum*. Capsules, 3–4 celled, ovate-acuminate. †

This plant is probably an *arboreum-herbaceum* hybrid; it much resembles the *Roji* of Gujarat, except in its annual habit, larger bracteoles and paler flowers.

* This conclusion is, I fear, hardly warranted. The seed supplied by the Forest Superintendent need not have been the so-called wild cotton of Marwar. It may have been an escape from cultivation found in a hedge row and presumed accordingly to be the wild plant. It is also just possible that the seeds of *G. neglectum* may have accidentally been mixed with the Marwar supply.—Editor.

† I have not examined the seeds of this cotton.

RAJPUTANA COTTONS.

Wild cottons.

GOSSYPIUM.

Descriptions of the

SIND
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(32) *G. Stocksii*, Mast.—The specimens I have seen were low straggling bushes, but in Sind the plant is said to be an extensive climber. *Stems* and branches glabrous. *Stipules* deciduous, small $\frac{3}{4}$ linear acuminate. *Petioles* equal to leaf-blades. *Leaves* deeply cordate, palmatifid 5-lobed; lobes rounded ovate, obtuse mucronate, young leaves with simple and stellate hairs not felted as in Broach cotton, full-grown leaves with a moderate number of branched and stellate hairs on both veins and mesophyll; old leaves with scattered stellate hairs, fairly numerous and with few or no simple hairs even on the ribs, midrib glandular. *Flowers* borne on secondary branches on very short peduncles $\frac{1}{2}$ " long, two or more flowers on each branch, at the base of the flowering branches entire orbicular leaves are sometimes found. *Bracteoles* deeply gashed as in *G. barbadense* and separate to the base, from 9–13 teeth enlarging in the fruit; glands at the base marked; veins are well marked. *Calyx* with five small teeth. *Corolla* yellow with red base, in the small stunted plants examined 1" across, $1\frac{1}{2}$ times as long as the bracteoles. *Stigma* united. *Capsules* 3-celled, ovate acuminate.

Except in the gashed bracteoles *G. Stocksii* does not resemble *G. barbadense*, and I believe its nearest relative to be *G. herbaceum*.

(33) *Persian Cotton*.—Small, much-branched bushes, herbaceous in character, with soft green stems, petioles, &c., like those of the Gujarat annual cottons and bright-green foliage with pale-green veins as in the leaves of *Wagria*; sparsely covered with hairs which are either simple or branched, none stellate as in Indian cottons. *Petioles* as long as, or longer than, the leaf-blades, sparsely covered with long delicate hairs. *Stipules* linear acuminate, sometimes falcate. *Leaves*, 5–7-lobed, palmatifid, deeply cordate; lobes constricted at the base and rising up in a fold, ovate mucronate, the sharp point is well marked on all the lobes; lobes of upper leaves markedly obtuse, mucronate, the youngest leaves thickly covered with simple and branched hairs, these quickly disappear and the old leaves are almost glabrous, a few simple and branched hairs on the veins; midrib and rarely other ribs glandular. *Flowers* on short peduncles on secondary branches. *Peduncles* short sub extra axillary. *Stipules* on peduncles markedly unequal, one-toothed. *Bracteoles* almost oval in outline, divided to the base of the ears, deeply cordate, inciso-dentate teeth acuminate, spreading after flowering. *Calyx* narrow, crenulate, green, large glands at base. *Corolla* small, $1\frac{1}{2}$ times length of bracteoles, not opening fully, pale-yellow, purple patches at base pale. *Stigma* united, each band with double rows of black glands.†

Origin.—Persian cotton corresponds closely with Todaro's *G. herbaceum*, and forms a connecting link between his species and the *Wagria* of Kachia-war. This plant is the only one (except *G. brasiliense*, and the glabrous *G. barbadense*) on which I have searched in vain for stellate hairs. In the obtuse leaves and the gashed bracteoles it recalls *G. Stocksii*.

X.—ASSAM COTTONS.

I received samples of seed from about a dozen different districts in Assam and grew all of them, but the change from the climate of Assam to that of Gujarat was too great to permit of minute distinctions showing themselves, and I have perhaps failed to note differences between plants, which may be marked in their native country; e.g., Mr. Darrah in his 'Report' quoted in the Dictionary of Economic Products, IV., 141, men-

* I have not examined the seeds of *G. Stocksii* nor the capsules and seeds of Persian cotton.

† I should describe *G. Stocksii* as densely coated with stellate hairs.—Editor.

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tions a tall and a small variety, but in Baroda all the varieties were about the same size. The most interesting point about Assam cottons is the particularly strong family likeness that runs through the group. The Assam region appears to have been the home of *G. roseum* or of a species that corresponds closely with Todaro's description of that plant, and it is probably from an Assamese stock that the inferior, but prolific *Varadi*, *Katil Belati*, *Mathia*, etc., have sprung. The deeply-cut leaves, large bracteoles, pale flowers, long bolls and coarse white wool are common to all these cottons.

(34) **Bungai Cotton** (in the Dictionary of Economic Products this name is spelt Bhugai). Samples of the seed were obtained from Karimganj and Habiganj, Sylhet.

Description.—Erect and little-branched plants standing 2 feet high; young parts of stem, petioles, etc., scantily covered with simple hairs; youngest leaves with stellate hairs; older leaves almost glabrous. Branches reddish, ascending or spreading. *Leaves* slightly cordate, palmatifid to palmatisect, leaves of the main stem palmatisect, 5–7-lobed; lobes lanceolate, or linear-lanceolate, acute, markedly constricted at the base, other leaves as in *Varadi*; sinus wide, extra lobe rare; midrib occasionally glandular. *Stipules* falcate, larger than in the *G. herbaceum* cottons; those on peduncles unequal. *Flowers* several on secondary or tertiary branches. *Bracteoles*, large, ovate acute, dentate or entire, united at the base; ears prominent, enlarging considerably in the fruit. *Corolla* small, a little longer than the bracteoles, yellow-white with a purple centre, convolute. *Stigmas* united. *Capsules*, 3-celled, ovate acuminate, about 1½ inches long; cells 7–8-seeded; seeds moderately large; hilum beaked; fuzz thick, greenish white; wool short and coarse, white, firmly adhering to the seed.

(35) **Bhoga Kapa** from Sibsagar closely resembles *Bungai*, it differs in having smaller seeds with a long beak, and in having 9–12 seeds in each cell. The cotton is finer than that of *Bungai*.

(36) **Khansa** from North Cachar is another very similar variety with still smaller seeds and with a much finer quality of cotton. Compared with the floss of the other Assam cottons, that of this variety is quite silky.

(37) **Kunma Cotton** from North Cachar is a larger and more robust plant than *Bungai*, with bigger leaves, flowers, bracteoles and bolls. The latter are acute or acuminate. Seeds, 8–11 in a cell, medium size, ovate with short beak; fuzz thick, greenish-white; wool coarse and short stapled.

(38) **Shet Cotton** from Lakhimpur.—In the habit and leaves this cotton closely resembles *Kunma*, but the bracteoles are more deeply cut, the flowers are smaller and change to pink very quickly on passing maturity, and the bolls, which are 3–4-celled, are much smaller, and pointed but not acuminate. Seeds 9–10 in cell, small to medium size; beak with white fuzz, and firmly adhering wool, which for Assam cotton is tolerably fine; staple short.

(39) **Ukynphad Cotton** from the Khasi and Jaintia Hills differs from *Bungai* in having much larger flowers which are nearly twice as long as the bracteoles. The stigmas are slightly divided at the apex and the capsules are 3–4-celled and pointed but not acuminate, 3-celled bolls are triangular in cross-section. Seeds 10 in a cell; small ovate with a moderate beak; fuzz very long, whitish-brown; wool short, coarse and firmly adhering to seed.

Ukynphad and *Shet* Cottons are much alike except in the fibre.

(40) **Kil Cotton** from the Garo Hills.—Habit, hairs and leaves as in *Bungai*. *Bracteoles* smaller than in other Assamese varieties, triangular,

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entire or sub-dentate. *Flowers* less than twice the length of the bracteoles. *Capsules* very large, triangular in cross-section, acute; cells 17—18, seeded; seeds large, flattened; beak sharp; fuzz abundant and whitish brown; wool white, but very coarse.

CONCLUDING REMARKS REGARDING ASSAM COTTONS.

In several of the Assamese plants and especially in the *K'il* variety, the floss is matted so that the seeds are not readily pulled asunder. When the capsule opens, the cotton bursts out and hangs down for several inches from the branches; against the dark-green foliage the appearance is effective and most peculiar.

From the Ghir Hills in Kathiawar some seed-cotton was brought me having precisely the same woolly matted character that distinguishes *K'il*. I planted the seeds, and found that the cotton was a member of the Assam series. How it got to the Ghir Hills is a mystery, the man from whom it came said that he had found the cotton growing wild, had sown some seeds beside his house, and had raised one plant. Neither he nor any of his acquaintances had ever seen any similar variety before.

During years of scarcity Khandesh cotton-seed finds its way to the Ghir for feeding cows, and it is perhaps possible that a *Varadi* plant had reverted to the character of its ancestors when growing wild in a hill climate.

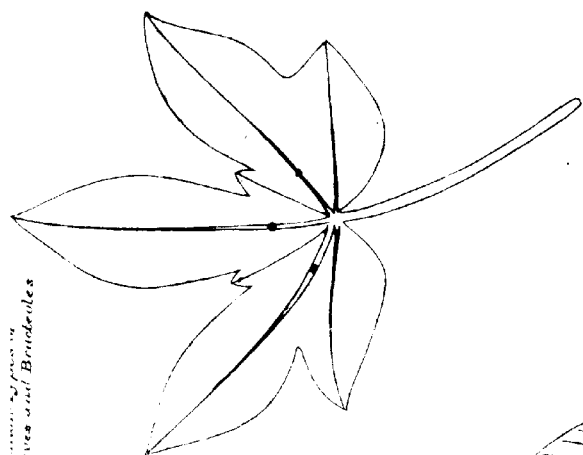
XI—MISCELLANEOUS AND FOREIGN COTTONS.

In addition to the foregoing plants there are several cottons which in a semi-wild or cultivated state are found in most parts of India. With the exception of *G. hirsutum* none is a field crop. They are described below.

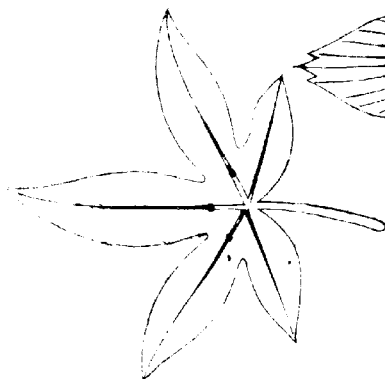
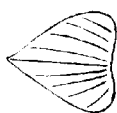
(41) *G. arboreum*, Linn.—A tall shrub with thin branches and red flowers. *Stems*, branches, petioles, leaf-veins, peduncles, and bracteoles, reddish-purple; branches, petioles, etc., with scattered simple hairs. *Leaves* slightly cordate, palmatifid to palmatipartite, usually 5-lobed; lobes lanceolate to narrow ovate, seldom constricted at the base; extra lobe common in sinus; midrib and usually side ribs glandular; margins never sinuate; leaves quite flat, dark-green, becoming leathery when old; buds with numerous stellate and simple hairs; old leaves almost glabrous. *Petioles* nearly equal in length to leaf-blades. *Stipules* small, linear, semi-falcate, those of peduncles unequal. *Bracts*, 3-lobed; lobes small and rounded. *Flowers* few. *Peduncles* short, extra axillary. *Bracteoles* small, ovate, sub-dentate or entire. *Calyx* truncate or sub-crenulate, shallow, with glands at base marked. *Corolla* twice the length of the bracteoles, deep red, opening fully. *Stigma* eglandular, slightly fid. *Capsules* mostly 3-celled, ovate acuminate, when 4-celled sub-globose; cells 6—8-seeded. *Seeds* covered with green fuzz; floss adhering loosely to seed, scanty, weak but silky.

This cotton is never cultivated in Gujarat and no pure form of it, so far as I am aware, is grown as a field crop in India. The cultivated *Narma* of the Panjab has the same colouring, but differs in several important respects from *G. arboreum* and is a hybrid variety. This species is now rarely met with in Gujarat gardens and must be much less common than when Vaupell wrote 50 years ago. It is called *Narma* or sometimes *Dev-Kapas*—names by which *G. barbadense* and *G. brasiliense* are also known.

(42) *G. barbadense*, Linn.—A much-branched glabrous perennial shrub from 6 to 10 feet high. *Stems*, branches, petioles red. *Leaves* cordate, 3—5-lobed, the majority 3-lobed, less than half cut; lobes triangular,
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markedly acuminate mucronate; midrib and occasionally side ribs glandular. *Petioles* thickened at the base as long as the leaf-blades. *Stipules* lanceolate, semi-falcate, reddish, those of peduncles sub-equal. *Bracts* often entire. *Flowers* usually 2-3 on short branches. *Peduncles* extra axillary, trigonous, shorter than the bracteoles. *Bracteoles* ovate, separate almost to base, deeply cordate, lacinate, with glands at the base less marked than in *G. hirsutum*. *Calyx* with truncate teeth; glands at base not nearly as well marked as in Indian species. *Corolla* yellow in bud, yellowish-white in flower, rapidly turning reddish-pink on passing maturity, slightly longer than the bracteoles. *Stigmas* with marked double rows of black glandular dots, united but not clavate as in *G. hirsutum*. *Capsules* mostly 4-celled, ovate, shorter than bracteoles, small compared with those of *G. hirsutum*; cells 7-seeded. *Seeds* black, free from fuzz except for a small tawny tuft at the hilum; floss long-stapled and silky, but weak.

This cotton is never cultivated in fields, but is occasionally grown in gardens along the water channels and boundaries. Stray plants are very common, and almost every large garden contains one or more. The crop is usually destroyed by boll-worm and other insects.

(43) *G. hirsutum*, Miller.*—Low-branched annuals. *Stems*, petioles, etc., red and covered with simple hairs. *Leaves* large, deeply cordate, palmatifid, usually 5-lobed except bracts which are 3-lobed; lobes ovate, not constricted at the base, acuminate; sinus rises up in a fold, but no extra lobe; midrib glandular; buds pubescent; hairs mostly simple, or branched, a few stellate; old leaves much less hairy than in the Indian representatives of *G. herbaceum*. *Stipules* broad, linear, falcate, those on peduncles sub-equal. *Petioles* nearly as long as the leaf-blades. *Flowers* 2-3 on secondary branches. *Peduncles* very short, extra axillary, trigonous, much thicker than in Indian cottons. *Bracteoles* cordate, ovate, lacinate from $\frac{1}{2}$ — $\frac{3}{4}$ as long as corolla, enlarging slightly in fruit as long as the bolls, with 3 large well-marked glands at the base. *Calyx* large, 5-fid, pale greenish-white; base eglandular. *Corolla* large, about 3" across, pure white when open, rapidly changing to reddish-pink, delicate in texture, membranous reticulate; petals cuneate. *Filaments* longer than in Indian cottons. *Stigmas* entire, clavate, glandular. *Capsules* mostly 4-celled, globose or elliptical with a very short blunt point, much larger and more rounded than in *G. barbadense*; cells, 7-seeded. *Seeds* ovoid, large, with long thick ash-coloured fuzz; beak short; floss white and silky, but short-stapled.

Seed of this cotton was sent to me from Bengal and said to be that of a very good variety cultivated as *Malgacha*. It is a prolific and useful cotton which ripens in 5-6 months (later than most American annual cottons); it grows very well on a sandy loam soil.

Except for a few stellate hairs on the leaves, and the fuzz on the seed which is not always present even in cultivated races of *G. herbaceum*, e.g. (*Tellapatiti* from Bellary), I see nothing to connect this plant with the herbaceous cottons of India. It differs markedly from *G. herbaceum* in the leaves, stipules, bracteoles, glands, calyx, corolla, and stigmas, and if it is a hybrid species, it bears no distinct traces of an Oriental origin.

(44) *G. religiosum*, Roxb.—A perennial cotton, with tawny floss, in habit resembling *G. barbadense*. *Stems*, petioles, etc., red and sparsely covered with simple hairs. *Leaves* cordate, 3-5-lobed, 5 lobes more frequent than in *G. barbadense*; lobes deeper cut than in *G. barbadense*,

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* At my suggestion Mr. Middleton has adopted *G. hirsutum*, Miller non Linn., as the correct name for this plant. *G. barbadense* above should similarly be *G. barbadense*, Linn, Sp. Pl. non Herb. See concluding note.—George Watt, Ed.

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palmatid as in *G. hirsutum*, but triangular acuminate, seldom ovate; hairs as in *G. hirsutum* but fewer. *Petioles* thickened at the base; stipules as in *G. barbadense*. *Flowers* several on lateral branches. *Peduncles* short, trigonous, extra axillary. *Bracteoles* laciniate as in *G. hirsutum*, more deeply cut than in *G. barbadense*, cordate with marked glands at the base. *Calyx* as in *G. hirsutum*, teeth sharp, not truncate as in *G. barbadense*. *Corolla* pale-yellow in bud, white when expanded, rapidly turning pink on fading. *Stigma* as in *G. barbadense*. *Capsules*, 3-4-celled, longer than bracteoles ovate, much longer than in *G. barbadense* and not globose as in *G. hirsutum*; cells 6-8-seeded. *Seeds* covered with a long tawny fuzz; beak short; floss tawny yellow; staple short.

Roxburgh describes the stipules as being cordate; when the stipules at the base of the peduncles are detached the insertion is cordate, as it is in *G. barbadense*, the insertion of the ordinary stipules is straight.

This cotton is not cultivated. Except in the perennial habit and tawny floss *G. religiosum*, Roxb., is closely allied to *G. hirsutum*, I believe the former to be simply a naturalized and perennial variety of the latter.

(45) *G. brasiliense*, Macf.—A large shrub occasionally 15 feet high. *Bark* smooth brown; herbaceous portion of stem, petioles and peduncles glabrous and covered with elliptical glandular dots. *Leaves* deeply cordate, very large, sometimes 8" x 12", 3-5-lobed; lobes ovate acuminate in the upper portions often lanceolate acuminate, occasionally entire; ribs glandular; margins of large leaves frequently have small lobes growing on them, and are slightly sinuate, nearly glabrous; young leaves with a few thin simple or branched hairs; sinus often folded. *Leaves* crowded at the ends of the branches, the smaller resemble those of Sea-Island cotton. *Peduncles* nearly as long as leaves, swollen at base. *Stipules* linear to lanceolate acuminate, those on peduncles unequal. *Flowers* solitary. *Peduncles* extra axillary, on secondary or tertiary branches, trigonous. *Bracteoles* large in flower and enlarging in fruit to 2" x 1 1/4" or more, deeply cordate, ovate, laciniate; glands at the base marked, as are also the glands at the base of the calyx. *Calyx* truncate. *Corolla* yellow convolute. *Bolls* mostly 3-celled, very long, ovate acuminate, 2" x 1" or more; seeds free from fuzz, adhering into a kidney-shaped mass.

This plant corresponds precisely with Roxburgh's description of *G. acuminatum*, and I think that *G. brasiliense* and *G. acuminatum* are synonymous.

The species is never cultivated, but is not uncommon in gardens where it usually goes by the name of *Deo-Kapas*.

THE IMPROVEMENT OF INDIAN COTTONS.

Although this paper deals with Indian cottons as they are, not with Indian cottons as they should be, it may not be out of place to offer a few suggestions on their improvement.

Apart from changes in the general system of cultivation which in different districts must be of very unequal merit, there are three methods open to those who wish to improve cotton: (1) Selection of seed, (2) Hybridisation, (3) Acclimatisation.

Selection of seed.—There are certain cottons for which this seems the only practicable method of improvement; to cross them with other kinds would probably result in a destruction of their valued properties; e.g., if the *G. herbaceum* of the Broach district, which is the best of our Indian species, and peculiarly suited to the deep-black loam in which it grows, were to be crossed with *G. indicum*,* the Broach cultivator might find that he had a new cotton which ripened earlier than the old, but which was

* Compare with page 12.

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less productive and less able to resist the excessive moisture to which his fields are subject in the monsoon, and if it were crossed with any of the other Indian species, the value of the staple would certainly deteriorate. Since he has a sufficient (generally more than sufficient) supply of rain in the monsoon, a deep-black soil which retains moisture for months, and—until the end of February—a moderately humid atmosphere, there is no plant that suits him so well as the race of *G. herbaceum* he calls *Deshi*, and the only way to improve his cotton is by careful culture and selection of seed.

Unfortunately selection of seed, although a certain method of improvement, is a slow process and one which only yields appreciable results after a more or less lengthy term of years; and unless the selection is maintained the crop will soon deteriorate to the old level. It is on this account that selection of seed, which is almost universal in gardens, is comparatively rare on farms. The farmer chooses good, sound, and healthy seed, but he seldom finds that the careful selection which repays the gardener is suited to his business. The ryot knows that the most carefully-picked seed is as nothing to the crop compared with clean soil or manure or a good season, and although he does select *Fowari* I am afraid that it would be difficult to get him to take the small amount of trouble that the collection of the best cotton seed would render necessary. At the same time there is not much danger that *Varadi*, or any other form of 'Bengals' will invade the cotton plains of Broach and Surat, for the cultivators know the value of their own plants very well, they do not wish an early variety, and if a stranger appeared they would remove it when weeding. Even if the ginners purchased 'Bengals' and mixed the seeds in ginning the cotton, I do not think that the Broach crop would become mixed; for if the practice became general at the gins the cultivators would then begin to select their own seed for sowing. In districts in which *Goghari* is grown the best cultivators do select their seed, otherwise they would get it from the gins mixed with *Deshi*. They will take the trouble to select seed for the purpose of keeping it pure, but I question whether they will be induced to do so for the improvement of an unmixed variety.

The selection of the seed of Broach cotton will be undertaken at the new Government Farm at Surat, and if the process proves successful, steps will no doubt be taken to induce the ryots to take up the work for themselves.

Hybridisation.—For the Broach and Surat Districts of Gujarat and for similar districts in other parts of India which enjoy a regular and moderate rainfall, I know of no better plant than *G. herbaceum*; but there are many districts which grow this species, e.g., Kathiawar, where the rainfall is uncertain and often proves insufficient. It is in these tracts that cultivators welcome the quick-ripening varieties that yield 'Bengals', and it is in places of this description where the soil is good, and fit ordinarily to ripen a crop of *G. herbaceum* that efforts should be made to prevent the entry of *G. roseum* and its depraved offspring and to provide new and better cottons suited to the districts. New and better cottons might almost certainly be got by crossing selected species and by carefully selecting the hybrids produced.

The numerous American varieties are the results of a careful selection of seed combined with cross-fertilization, natural or artificial. In 1892, I addressed several queries on this subject to American correspondents, and as their replies show what America is doing for its cotton plant I give some extracts—

Professor Tracey, Director of the Mississippi Agricultural Experiment

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Station, writes: "In reply to your inquiries, (1) There is no trouble whatever in crossing different varieties of *G. herbaceum*.*

I have secured a few hybrids between the two species, but they are somewhat difficult to obtain, and, so far, have not proved to be of much value. (2) The larger part of our improved varieties have been obtained by selection, though many of them are doubtless natural crosses. (3) We have both *G. barbadense* and *G. herbaceum* in cultivation here, though usually in different localities. The former succeeds well only near the coast, while the latter is the better variety for inland plantations."

Professor Mell, Botanist to the Alabama Agricultural Experiment Station, says: "Cotton here hybridizes readily, and I think it is a product of Indian, Mexican and West Indian cottons. I am not sure of this, however, and am continuing my examination of it."

Mr. Gustave Speth, Horticulturist, Agricultural Experiment Station, Georgia, remarks that until recently American selectors of cotton-seed were content to work with the products of chance cross-fertilization, and he adds: "In such a case all improvements are accidental; with our present knowledge we go further, we propose carrying on our operations in specific directions, in our work we have always a specific object in view, for instance, to change the formation of plants or to improve the length of the staple of prolific varieties having short staples. Cross-fertilization is only the first step in the improvement of the cotton plant. Breeding and selection are of almost greater importance, as often 4-6 plants of entirely different growth and formation is the result of the second year's seed (care, of course, being taken to prevent crossing by accident). Cotton is easily hybridized with the necessary care and study, but it does not mix in the field to any serious extent. "Our cultivated forms I consider to be *G. barbadense*."

Professor Newman, of South Carolina, writes: "I have found the cross-fertilization of varieties of cotton grown in close proximity very slight. In making new varieties more dependence is placed on the careful selection of seed from typical plants than on hybridisation. Good results have been obtained by crossing the black-seeded long staple or 'Sea-Island' on the more prolific Upland varieties."

My correspondents and other scientific men in the United States are devoting their time to the improvement of the cottons of the New World, whilst the Eastern plant, except in some naturally favoured districts, is going from bad to worse, and the production of new varieties to take the place of old and worn-out races is being left to chance.

There is no reason why this should be, for experiments on the artificial crossing of cottons could easily be undertaken at existing Government Farms and Gardens at a very small cost, provided proper supervision existed.

What we want in India at present is a cotton that suits clay soil, ripens within six months and produces a good staple and a fair yield, the *Bani* of the Central Provinces at one time supplied most of these required, but it is not hardy and the outturn is small, so that it is dying out and very inferior plants are taking its place. Every effort should be made to preserve this stock, for if it can be got to cross with the *Deshi* of Broach or even the *Wagria* of Kathiawar, I think there would be every chance of securing a cotton that, with judicious breeding and selection, might be of the greatest value to the country. *Bani* has a fine silky staple and ripens early, *Deshi* is productive, has small bracteoles (and so the cotton is free from leaf) and has a long silky staple of fairly good

* The *G. herbaceum* of American authors is *G. hirsutum*, Miller. See concluding note.—*Geo ge Wath*.

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many parts of India, the other too late; a combination of their properties colour, both plants grow on clay soil, but one ripens early, too early for should produce a cotton that would combat the advance of 'Bengals' more effectively than "Ashburner Acts" or any quantity of "Cotton Frauds" legislation.

The ryots' sole object is to get as many rupees for his crop as he can, and he cannot be expected to cultivate a worn-out and delicate plant, however good the staple, in preference to a hardy species that produces a more certain yield; the true remedy for his so-called ignorant preference for short-stapled cotton, is to provide a more paying long-stapled variety.

We may term cotton fields like those of Broach, which are able, in the great majority of seasons, to produce a crop of *G. herbaceum*, the first-class cotton land of India. Soils like those of Kathiawar, Khandesh, Berar and the Central Provinces which in the past or still produce *G. herbaceum* or *G. indicum*, but on which these crops are precarious, and are giving place to inferior sorts, may be termed second-class cotton soil. There remains a very large area of third-class cotton land which is too sandy or has too small a rainfall to ripen any of the finer races, on this land the perennial cottons of Gujarat and Madras and the bulk of the 'Bengals' of commerce are raised. From the commercial point of view nothing could be much worse than the fibre produced by this third-class soil, and there is a very large field for improvement.

For inferior land it is essential that we have a quick-ripening (4-6 months) cotton and for the rest the finer, whiter and more abundant the fibre the better. To secure a cotton for light soils and dry climates, attention should be paid to the crossing of the prolific, hardy and white-woolled *G. roseum* with the finer *G. indicum*. The former species should be discouraged on all soils which have hitherto yielded *G. herbaceum* or *G. indicum*, but it may usefully be employed in producing hybrid cottons for inferior districts.

Acclimatisation.—The only Indian cottons worth attempting to raise in districts where they are not already known are *G. herbaceum* and *G. indicum*, and there is not much scope for the introduction of either. The former is probably now grown on all the land suitable for it. Experiments made with Broach cotton in the Central Provinces have failed, the atmosphere of the district was too dry at the season when the plant ripened and the staple was consequently weak and inferior. *G. indicum* might possibly be introduced with advantage into districts which have hardly sufficient rainfall to ripen the *G. herbaceum* now grown there. It would certainly be better to have *Bani* than the *Varadi* which threatens Kathiawar, but better than either would be a cotton combining the characters of *Bani* and Broach *Deshi*.

Whilst there is little that can be done in the acclimatising of indigenous growths, there is a certain amount of scope for the introduction of foreign cottons. Such numberless attempts have been made to raise American varieties and such numberless failures have been reported, that one is apt to forget that there have been successes. The most notable of these was in Dharwar, but the exotic cotton has deteriorated there and is now of poor quality. I do not know the district, but I cannot help thinking that the cause of deterioration is mainly neglect, and that if the stock had been as carefully nursed in India as it is in America, there would have been no complaints of the Dharwar cotton of to-day.

I do not think that hybridisation has been instrumental in bringing about deterioration, for with the exception of Okra-leaf cotton* I have never met with any hybrids between the cottons of the Old and the New World, and I do not think that the species cross easily; but I think that the Dharwar seed has "run out" and wants renewal. Not only in Dharwar, but in

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* Okra leaf cotton seems to me to combine the characters of *G. hirsutum* with those of *G. roseum*.

GOSSYPIMUM.

Descriptions of the

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isolated districts of Bengal, the Punjab, the Central Provinces and Kathiawar, *G. hirsutum* has obtained a footing, and I am sure that there is a distinct field for this cotton in India. It does not thrive on heavy clay soils like those of Broach, and it cannot stand a heavy rainfall when young; but with a light rainfall and on a free well-drained soil it grows well. Its great merit is that it ripens in 4—5 months, grows on light soils unfit to produce the better classes of Indian cotton, and consequently where it succeeds, it would take the place of our worst kinds. I have grown about a hundred cottons received from all parts of India at the College Farm, Baroda, and none has done better than an acclimatised race of *G. hirsutum* sent to me from Bengal. *G. barbadense* grows well as a perennial, but is always infested and the crop destroyed by boll-worm. I have seen a few experimental patches of Sea-Island cotton grown in Gujarat, but nowhere was it successful.

By judiciously employing the methods I have indicated and especially by hybridising and breeding select strains of the hybrids I believe that India might become possessed of new and better strains of cotton than even she has known before. I know that hybridisation is no new thing in this country, and that many experimenters have tried it with discouraging results, but their results were due chiefly to attempting too much, viz., the crossing of indigenous species with *G. barbadense*. The most persistent attempts made in the Bombay Presidency were those of Elphinstone who succeeded in obtaining crosses between *G. barbadense* and *G. herbaceum* with difficulty, only to find that they were of little value. The experience of Professor Tracey, of Mississippi, in his attempts to cross *G. hirsutum* and *G. barbadense* was similar. But these failures do not prove anything with respect to the crossing of *G. herbaceum* and *G. indicum*, nothing short of actual trial will show what these two will do and the experiment is one which is worth making; they will probably be found capable of being crossed without much trouble and the hybrids, if taken care of, would certainly be valuable.

The small success which has attended the numerous attempts made by Government to improve Indian cotton, has undoubtedly been due to the neglect of the native species, and before any general attempt at improvement is again made, the botanical and agricultural peculiarities of the Indian races must be thoroughly investigated; the foregoing notes are merely of a preliminary description, and I hope that the different Government Farms will take up and develop the work. Each Farm should collect all the varieties of cotton known in its own province, grow them side by side and publish descriptions. Whenever practicable, the cottons should be studied as field crops in their own districts as well as on the central station. If this were done for a year or two, a complete account of Indian cottons could be written, and Government would be in a position to deal with the general improvement of the fibre.

For the future cotton plant of all the finest cotton soil of India we must depend upon indigenous races. These races are by no means few, and among them there are varieties of great merit, varieties which in the past, even when left to chance, have developed celebrated fibres. But the day is past when any cotton-growing country can afford to depend on chance. The increased attention which America is giving to the production of new varieties and good seed is sure to make its influence felt in the market. Egypt will follow the United States, for her cottons all come from the New World; and if India neglects the improvement of her indigenous varieties, the prospects of her cotton industry are not encouraging.

The existence of a large quantity of machinery constructed for dealing with short-staple cotton gives an artificial value to the inferior growths of this country at the present time, but in view of the abundant supply of superior cotton now in the market, it is likely that as these machines

Chief Cultivated Cottons.

GOSSYPIMUM.

wear out they will be replaced by others made for a longer staple, and consequently that the demand for the poorer qualities of cotton will greatly diminish; cultivators will then find that *Varadi*, *Fari* and other prolific short staple varieties are not the profitable crops they now are, and they will wish, when it may be too late, that they again possessed the superior kinds that have been, or now are being, driven out of cultivation.

CONCLUDING
NOTE.*Concluding Note by the Editor.*

During the cold season of 1893 I had the pleasure to enjoy Professor Middleton's company during part of my explorations of the cotton fields of Gujerat. We interchanged ideas and put our various theories to practical test by comparing the living plants district by district and almost field by field. Professor Middleton made at the same time an extensive collection of seeds. These were sown at Baroda together with supplies obtained from other parts of India. His remarks above, constitute a most valuable contribution to our knowledge of the cotton plants of India. They incorporate his continuous observations and are particularly valuable as denoting variations in form due to altered environment. When I add, therefore, that I do not accept some of Professor Middleton's botanical interpretations I should not be regarded as wishing in any way to detract from the value of the above paper. The subject of the origin of the cultivated races of cotton in the world, is a problem which unfortunately has its parallel if not its origin in the obscurity that involves the determination of even the species of *Gossypium*. While a very large proportion of the cotton area of India still remains to be explored by me, I do not propose to publish my peculiar views of the botanical problems briefly touched on by Professor Middleton. I may say, however, that the errors that obscure the study have passed down from the very earliest times, so that certain species described by even Linnæus himself in his *Species Plantarum* will have to be spoken of in future as not being the species of that name in his herbarium. If, therefore, uncertainty exists as to the exact plants meant by Linnæus under such names, for example, as *Gossypium barbadense*, *G. hirsutum* and even *G. arboreum*, it is no wonder that numerous subsequent writers have got hopelessly confused and new names such as *G. obtusifolium*, *G. indicum*, *G. Wightianum*, *G. roseum*, and *G. neglectum* have been proposed and rejected or translated from one form to another. The writer had the pleasure recently to receive a large and valuable collection of botanical specimens of *Gossypium* from the United States of America. These proved of exceptional interest since they revealed the fact that *G. herbaceum* of American writers was for the most part neither the *G. herbaceum*, *Linn. Sp. Pl.*, nor *G. herbaceum*, *Linn. Herb.* The interest in this matter turns mainly in the interpretation that must now be placed on the so-called American hybrids between that species and *G. barbadense*. Indeed it is from an exactly similar reason that the whole problem of the solution of the species of *Gossypium* calls most urgently for solution. Until we are in a position to say so and so are definite forms, varieties, or species, we are not in a position to propose the steps that should be taken in the direction of improvement of stock.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series as well as under the specific names of the products. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series. Those of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom, or if of a collective nature they will be placed under the Agricultural, Industrial, or Forest Series. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series in addition to that of the name of the mineral dealt with.

This sheet and the title-page may be removed when the subject-matter is filed in its proper place, according to the letter and number shown at the bottom of each page.